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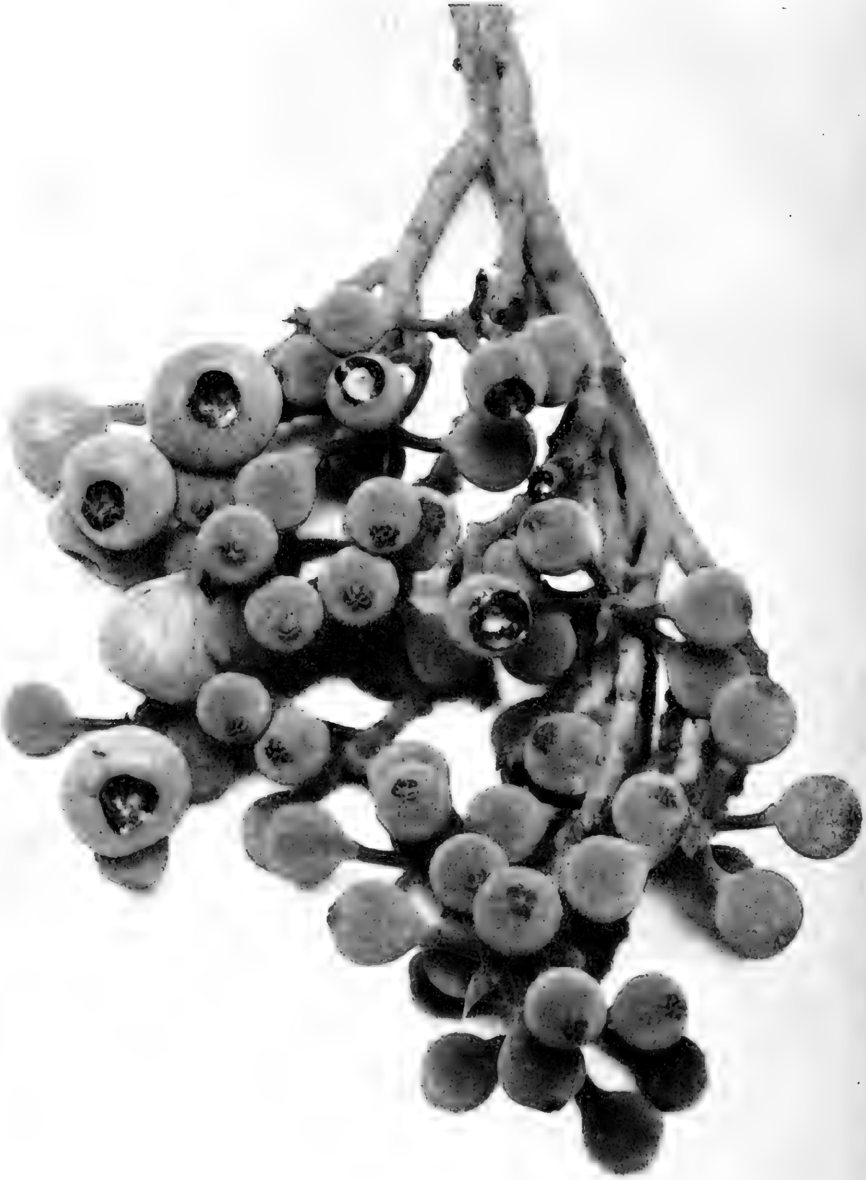


SYCAMORE FIGS

Since the dawn of history, the sycamore fig has played a prominent part in the life of the people of Egypt and a few other oriental regions. The fact that it yields fruit throughout the entire year, perhaps, contributes to the esteem in which it is held; for to a westerner its fruit seems of little value, being small and without a particularly pleasing flavor, and only partly edible. Each fruit is entered by a small wasp, which lays eggs in it; the Egyptians, therefore, make holes in the ends of the fruits while they are still small, to admit air and keep the eggs from hatching. The variety here illustrated is that known as Roumi, which is the favorite at Cairo. (Frontispiece.)

THE SYCAMORE FIG IN EGYPT

Historic Tree is Widely Grown, and Furnishes Large Quantity of Inferior Fruit—Interesting Practices of the Natives—Life History of the Fig-Wasp

Thomas W. Brown and F. G. Walsingham
Cairo, Egypt

PERHAPS no tree in the world has to the same extent as the sycamore occupied the pens of writers from the dawn of history to the present time. It was one of the sacred trees of Arabia and Ancient Egypt, and in olden times played an important part in the cult of the dead. The sycamore was also the tree of Hathor, the goddess of love and marriage, on which account the lovers of Ancient Egypt were wont to tarry fondly under its branches in the hope of receiving the goddess' blessings. Even today, a vestige of this belief can be seen in the custom of women visiting the sycamore when troubled with matrimonial cares.

The sycamore is frequently mentioned in the Scriptures. The story of Zaccheus climbing a sycamore tree is, of course, familiar.

Amos was probably a gatherer of sycamore fruit. Muschler, in his Manual Flora of Egypt, describes the instrument used at the present time to cut the fruit open in order to ripen it, and in this connection he states that the process as described by Pliny closely corresponds with the modern method and, further, that "it would seem to be pretty certain that Amos performed identically the same operation on the figs as is still done in Egypt at this day."

The word "sycamore" which is derived from the two Greek words "Sucon" (fig), and "moro" (mulberry), is an appropriate name for this tree, because the leaves are not unlike those of a mulberry and the fruit closely resembles that of a common fig. The tree is also known as Pharaoh's fig.

The sycamore is found throughout Egypt—in the Delta, Nile Valley, and also in the Oases. It is a large evergreen tree with a round symmetrical head when young. The trunk is usually short, and as the tree increases in age the branches spread out more or less horizontally to a radius of 15 to 20 meters. The leaves are ovate, alternate and almost glabrous on both surfaces; petiole about half the length of the blade, furry pubescent; shoot pubescent, furnished with a ring of stipular hairs at the insertion of each leaf. The bark retains its herbaceous character for several years, eventually becoming grayish-brown in color, but without any fissures.

The fruit is borne almost entirely on specialized leafless branches, which arise on the ordinary vegetative branches. Rarely, a few figs are borne on the leaf-bearing shoots. The fruiting shoots generally appear first at points on the vegetative branches where the latter have a diameter of about 6 cm., although occasionally they are found on smaller branches. The internodes of the fruiting shoots are almost wholly suppressed so that growth in length is very slow. Secondary shoots are given off in a racemose manner at irregular intervals until a dense, much-divided fruiting branch is formed. These branches attain a length of about 30 cm. They persist for many years and may be found on the mother branches when the latter have attained a diameter of 30 to 40 cm.

FLOWERS ARE PECULIAR

Flowers of the fig trees commence bearing at the age of 5 to 6 years. The figs arise singly or in pairs in the axils of the fugacious scale-leaves of the fruit-bearing shoots. They attain a

YOUNG SYCAMORE FIG TREE

Once a year, and always on the same day, the Egyptians make a ring of bruises and scars in the bark of the trunks of their sycamore fig trees, under the belief that this makes them bear better. This custom, like many others in primitive agriculture, is doubtless a combination of pure superstition and empirical science. The idea that the trunk must be injured only on a certain saint's day appears to be superstitious; but the idea that it bears better with such treatment is borne out to some extent by modern experimental horticulture. It has frequently been found that ringing or girdling the trunk of a fruit tree will improve its yield. This may be due, in part at least, to the fact that starch and sugar, manufactured in the leaves, are prevented from descending in the soft inner bark and, being kept in the branches of the tree, form a stimulus to the production and maturation of fruit. The variety here shown is that known as Roumi at Cairo (Fig. 1).

maximum diameter of 65 mm. and a length of 45 mm. The figs of the autumn crops are somewhat smaller than those of the summer crops. The inner surface of the fig is occupied entirely with female flowers, with the exception of a group of staminate flowers which encircle the "eye." The female flower consists of a rudimentary perianth enclosing the ovary, and the latter is surmounted by a comparatively long style which is curved at the apex as shown in the drawing. It is usually supposed that the male flowers in these figs are all aborted. This, however, is not invariably true, as, especially in the late summer months, many of the figs have male flowers with well-developed stamens.

There are, as far as we know, two varieties of sycamore in Egypt. The most important of these is that known as "Roumi," Turki or Falaki. As compared with "Kelabi," by which name the second variety is known at Cairo, the branches of the old trees of the Roumi spread out more horizontally, the shoots are stouter, and the leaves, as a rule, are set more closely together on the twigs. The leaves are broader in comparison to their length and the petioles are shorter and stouter than those of the other variety. The fruit is broad and flat, pink in color, and larger than that of the Kelabi. In the Kelabi the branches are ascending but they are not so stout as those of the Roumi. As compared with the Roumi, the shoots and petioles are more slender and the leaves and fruits are smaller. The figs are pear-shaped and pale yellow in color.

The Kelabi is never eaten at Cairo, but at Alexandria and in some of the provincial districts the same variety is known as the Beledi or Arabi, and the fruit is used in the same way as the Roumi. The Beledi is usually looked upon as being a distinct variety, but careful comparison of the trees has led us to the conclusion that the slight differences which exist in the shoots and leaves are due to climatic effects in maritime districts.

Figs are found upon the trees at all seasons of the year. In the case of the Roumi, which is the principal variety at Cairo, the young fruits of the first crop appear about the beginning of April. They almost all appear within a period of 4 to 5 days, after which very few fruits are produced until the next crop arises. The first crop is known at Cairo as "Iskat." It is usually a good crop, but not so abundant as the two following ones.

The fruits of the second crop appear as small buttons in the first week of May. This is known at Cairo as "Dor Kamel." It is always a better crop than the first.

The production of young figs during the interval between the second and third crops is more plentiful than during the period between the first and the second crops. Nevertheless the reduction of the number produced at the time is sufficiently great to make the third crop quite distinct from the second. The third crop commences to appear in the first half of June. It is known at Cairo as "Sereya." After the appearance of the third crop there is a continuous but less abundant production of fruit during the autumn and even throughout the winter. Cultivators usually divide this into a fourth and a fifth crop. The fourth is called the "Sayeh" and the fifth is known as the "Dahabiya" crop. There is, however, no definite break in the production of the figs to distinguish the third crop from the fourth and the fourth from the fifth.

Before leaving the question of crops, it is necessary to point out that all the trees of the same variety of sycamore do not act exactly alike: the crop of one tree may not commence to grow until four or five days or even more after that of a neighboring tree. In the case of the Kelabi, the first crop appears later in the season than that of the Roumi.

THE FIG-WASP

What we have said, however, applies in all important respects to the sycamore generally. The fruits of the sycamore are always inhabited by the insect

SYCAMORE FIGS ARE BORNE ON THE OLD WOOD

Most trees bear fruit on the younger twigs and branches, but a few, among which is the sycamore fig, produce nearly all their fruit on older wood. In this case, short, specialized branches are put forth directly from the trunk. The fruit of the fig is almost unique in character, consisting of a fleshy receptacle holding a large cluster of small flowers on its inner surface. These flowers make up the "flesh" of the fruit that is eaten. Each flower contains a single ovule, and the whole receptacle is open to the air at its apex. Through this opening the fig-wasp crawls, and lays an egg in every flower, thus preventing the development of the seed. The sycamore fig is, therefore, propagated artificially, by cuttings, and in Egypt it appears that seedlings are quite unknown. (Fig. 2.)

SYCAMORE FIGS GROWN IN ALGERIA

The Egyptian grower gouges a small hole in the end of the ripening fruit, to admit air and prevent the eggs of the fig-wasp from hatching. The Algerian merely slices the end of the fruit off with a knife. The tree is rare in Algeria. Photograph, natural size, made at Biskra, Algeria, in 1900, by David Fairchild. (Fig. 3.)

Sycophaga crassipes. These little wasps use the ovaries of the flowers as cells in which to lay their eggs and rear their young. After the eggs are laid, each ovary increases in size, in order to accommodate the insect which develops inside. The young insects which first leave the cells are all males; they are wingless and dark brown in color. As soon as they come out they fecundate the females whilst the latter are still in the cells, in which they have been hatched. When the work of fecundation is finished, the females leave their cells and the males die. The latter may usually be found dead in a cluster just inside the "eye" of the fruit in which they have passed their life. The females are shiny black in color, and are furnished with two pairs of wings and a long ovipositor. As compared with the males, they are somewhat short. As soon as the female leaves the cells she makes her way through the "eye" of the fig to the open air. Sometimes she does not come out by way of the "eye" but through a hole which she cuts in the wall of the fruit. This, however, does not occur frequently. As soon as she has escaped from the old fig she flies to another which is still in the early stage of development. Alighting on this she forces her way between the closely fitting scales of the "eye" until she reaches the interior. This operation usually causes her to

lose her wings. The presence of these protruding from the "eye" is a sure sign that the wasps have entered the fig. The presence of a minute hardened drop of sap also denotes the entry of the wasps. When they have reached the cavity of the fig they proceed to lay an egg in each flower, after which they die.

The number of insects which enter each fig varies between two and thirty-six. They are more plentiful in autumn than at any other season. At that time the number of eggs laid in each fruit is at least 1,000. This is the number actually counted, but there must have been many more which escaped observation in the disintegration of the flowers.

In summer the insects enter the figs when the latter are 15 to 20 days old.

CHANGES IN THE FIG

As soon as the eggs are laid, the fig commences to secrete a watery fluid which eventually fills the cavity to about one-fourth of its capacity.

Before the time arrives for the young insects to emerge from their cells, the fluid is again absorbed and the interior of the fig returns to its original condition. The period which elapses between the laying of the eggs and the emergence of the young insects is about a month. The development of the wasps thus coincides with the growth of the figs, so that when the females leave the fruits of one crop, those of the following crop are ready to receive them. This may be represented approximately as follows:

Crop No. 1

Commences growth April 1
Insects enter figs April 15
Young insects emerge May 15

Crop No. 2

May 1, commences growth
May 15, insects enter
June 15, young insects emerge.

As we have already explained, in autumn there is a continuous production of fruits so that whenever the wasps come out of the mature figs they find others of a suitable age in which to lay their eggs. In winter the growth of both figs and insects is slower than in summer.

We have not been able to find seeds in any of the figs. It therefore appears that the only *raison d'être* of the figs is to provide food and shelter for the wasps.

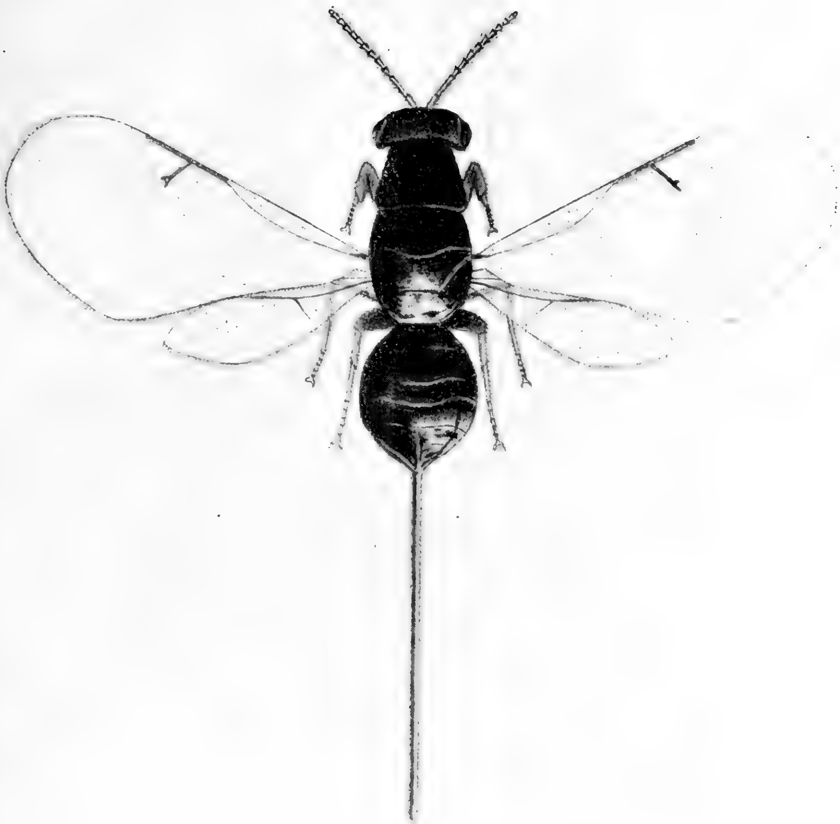
In fact, experiments tend to prove that, in the absence of the insects, the figs are not able to continue their growth beyond the initial stages.

We have surrounded the young fruits with muslin bags and thus prevented the access of the Sycophaga to the figs, and in no case has the usual secretion of liquid taken place inside, but, on the other hand, after the lapse of a few days the figs have shrivelled and fallen. The presence of the wasp, therefore, appears to be an essential condition for the development of the fig itself. We naturally suppose that the use of the fig to the tree in its primitive state was the production of seed for the propagation of the species.

SEEDS SOMETIMES PRODUCED

Sickenberger in his "Contributions à la flore de l'Egypte" states that the tree produces perfect seeds in Nubia, Abyssinia and Yemen. Inquiries made in the first-named country have not enabled us to confirm that statement. As stated by Muschler, Dr. Schweinfurth saw many seedling trees growing spontaneously in the Yemen, so that the tree evidently still retains the power of producing good seed there. The question, therefore, arises: Is the Sycophaga not found in that country and have the figs been adapted to the needs of the insects since the tree came to Egypt? We may also ask whether in that country the seed-bearing flowers exist side by side with others in which the insect breeds, as is the case in the caprifig.

It has been stated that the sycamore insect is that which effects caprification of the common fig in Malta, but this statement does not appear to be based upon fact. In this connection it is interesting to compare the common caprifig insect *Blastophaga grossorum* with the Sycamore wasp *Sycophaga crassipes.*



THE FEMALE SYCAMORE FIG-WASP

This wasp is less than one-eighth of an inch in length; its existence seems to depend wholly on the sycamore fig. Its abdomen terminates in a long, slender tube, the ovipositor, nicely adapted for reaching down into the fig flower and depositing an egg at its base. In crawling through the small opening at the end of the fig, the female usually loses her wings, and subsequently dies. When the young hatch, they develop rapidly, emerge from the fig in which they were born, and the females fly to other figs, where they lay their own eggs and then die. The fact that sycamore figs ripen throughout almost the entire year, makes this life-cycle for the insect possible. While the existence of the fig-wasp is made possible by the tree, it would appear that naturally the existence of the tree is made almost impossible by the wasp, since it prevents seeds from developing in the fruit and the species would, therefore, apparently die from inability to perpetuate itself, were it not propagated by the farmers who want its fruit. (Fig. 4.)

It is found that the ovipositor of the former is quite short, consequently the insect is able to deposit its eggs in the ovaries of short-styled flowers only. The eggs are laid almost entirely in the gall flowers of the caprifig. These gall flowers are female flowers which have become modified and adapted to the

FLOWER OF THE FIG

The "fruit" consists virtually of a cluster of these flowers turned inside out. The flower has a long bottle-neck style; hence the fig-wasp has to have a very long ovipositor, as shown in the preceding drawing, in order to deposit her egg in the ovary of the flower, indicated in outline at the base. (Fig. 5.)

needs of the insect. As compared with the normal female flower the pistil of the gall flower has been greatly shortened so that the caprifig insect with its short ovipositor is able to reach the ovary. The sycamore insect, on the other hand, has evolved a long ovipositor and no modification is apparent in the length of the pistils of the Sycamore flowers.

As we have seen, the sycamore does not produce seed in Egypt, and as it has no means of natural vegetative reproduction, it depends entirely upon human agencies for its perpetuation. Propagation is effected entirely by means of cuttings. The tree is of quick growth, but for its full development it requires plenty of moisture.

When it has become sufficiently old to bear fruit, the fellaheen make a ring around the trunk by beating the bark with a wooden club. A fresh ring is made each year in the month of January, just above the ring of the previous year. This goes on year after year until the entire trunk and larger branches wear the scarred appearance so characteristic of the tree in Egypt. The treatment is supposed to make the tree bear more abundantly than otherwise.

When the fruit is fifteen to twenty days old, a hole 1½ to 2 cm. in diameter is made at the top or in the side of the fig. In Cairo district the hole is circular in shape and is made with a special instrument. This is a ring of flat iron attached to a handle about 6 cm. long. Expert workmen are able to use a cutter in each hand.

In the provinces, the holes are often made longitudinally with an ordinary knife. The operation of cutting the figs is done by men who are called "gemamzia." Women are sometimes employed also. Both men and women become most expert in climbing the trees and they often remind one of the scenes depicted on the ancient monuments showing monkeys among the branches of the trees. These animals are supposed to have been trained in olden times to gather the fruit and throw it to the men below.

At Cairo the fruits of the first crop are operated upon in the early morning, but in the case of the two succeeding crops, when the weather is hot the operation is carried out in the late afternoon. The work extends over a period of two to three days for each crop, and the fruit is ready for gathering four or five days after the holes have been made. In the Cairo district the figs of the third and following crops are not eaten, but in the provinces

the work of cutting and harvesting continues until the month of November. Fruit which is not operated upon continues its growth and its inner surface becomes covered with expanded flower cells containing the young insects or cells from which the insects have escaped. Figs in this state are known as "badh." Needless to say they are disagreeable to eat. When the young fruit is opened in the manner described above, the influence of the air causes the flowers inside to dry and form a compact mass, in which the insects cannot lay their eggs. The drying effect of the air also stops the development of any eggs which may have been deposited previously. The presence of the fluid which is secreted in the interior of the fig is essential to the welfare of the eggs, and when the air is admitted, the liquid evaporates and all further development is stopped. As already stated, the fruit is afterwards allowed to ripen four or five days, when it is ready for consumption.

The usual explanation of the figs being cut to allow the wasps to escape is not correct. If the operation is postponed until the eggs have been hatched the admittance of the air will not prevent the young insects leaving the cells, but the cultivators are careful not to postpone the work until that time. The branches are usually surrounded with nets as soon as the figs are opened. This protects the fruit from bats and birds, and prevents any of it falling to the ground and being spoiled. It is always collected by hand. All the work in connection with the crop, including the beating of the tree, is done by the "gemamzia" who buy the year's fruit in advance. A good tree brings as much as £1 per year.

The owner of the tree seldom gathers the fruit or sells it by measure, unless in the case of small trees in the fields, where the quantity is not sufficient to attract the merchants.

A DEVELOPING FLOWER

The greatly enlarged ovary of the flower indicates that a young fig-wasp has hatched out and is developing inside. When this takes place, the inside of the fruit fills up with a liquid which it secretes. When the Egyptian cuts a hole in the end of the fruit, this liquid dries up and the fig is rendered edible. (Fig. 6.)

USES OF THE TREE

In olden times the timber of the sycamore appears to have been extensively used in the industrial arts. The wood was seasoned in water to make it hard and unchangeable. Its power of resisting decay when immersed in water is still appreciated and we find that its principal use today is in the construction of wells.

As a tree, the sycamore supports town conditions quite well; it requires severe pruning to keep its spreading branches within the limits of a street

tree. It is more suitable for planting along suburban roads where it has plenty of space to spread out on each side. Nothing is more picturesque than an avenue of sycamores, and as a shade tree in rural districts it is unsurpassed, but the great spread of its branches makes it objectionable in situations where it is in close proximity to cultivated land.

In ancient times the latex of the fig was supposed to be an efficacious remedy in cases of snake and scorpion bites. We are not aware that it is still used in such cases, although the fellaheen often apply it as a remedy for skin diseases.

Miscegenation in Hawaii

Out of 210 American grooms married in Hawaii during 1914, only 53.3% married American women, 11.9% married Caucasian-Hawaiian women, 11.9% married Portuguese women, 5.2% married full-blood Hawaiian women, 1.9% married Chinese-Hawaiian women, 1.4% married full-blood Chinese women, 1.9% married Porto Rican women, and the remainder included British, Filipino, French, German, Japanese, Mexican-Portuguese, Norwegian, Spanish and Swedish women. Dr. Frederick L. Hoffman, who publishes these figures in a pamphlet on The Sanitary Progress and Vital Statistics of Hawaii, says all observations show that the intermixture of native women with full-blood Chinese has produced a physically and morally superior type.

Eugenics as the Basis of Sociology

THE PHYSICAL BASIS OF SOCIETY, by Carl Kelsey, Professor of Sociology, University of Pennsylvania. Pp. 406. Price, $2.00 net. New York: D. Appleton & Co., 1916.

As an introduction to the study of sociology, Prof. Kelsey has compiled what is practically a text-book of eugenics. He has usually followed good authorities and (excepting the weak chapter on racial differences) his biology is on the whole sound. One wishes that Prof. Kelsey had used his sociological knowledge to make an original contribution to applied eugenics: perhaps he will do so in a future volume. The present book will interest biologists as showing what parts of their work most impress a sympathetic sociologist; and if used by other sociologists as it is by the author, to introduce a course in sociology, it will be of much value in giving the student the proper start.

Huntington's Chorea and Heredity

Huntington's Chorea is a form of mental deterioration associated with nervous tremors of the body. Dr. C. B. Davenport and Dr. Elizabeth Muncey have completed a study of nearly one thousand cases, all of which trace back to six individuals, and publish their results as Bulletin No. 17 of the Eugenics Record Office. The defect is highly hereditary, seldom if ever skipping a generation, and is associated with other nervous traits. It does not seem to be dying out through marriage selection; moreover, new sources are coming into the United States at present through immigration. State and federal action to prevent the increase of this serious taint appears to be justified.

Meeting on Saturday Not Open to Public

Dr. C. B. Davenport writes that, because of the limited accommodations at the Carnegie Institution's Station in Cold Spring Harbor, Long Island, invitation to visit it on Saturday, December 30, is limited to the Society of Naturalists.

THE MODERN IDEA OF EVOLUTION

Darwin's Work Corrected and Amplified, But Its Essential Parts Not Supplanted—Cause of Variations Still a Mystery But Manner of Their Inheritance Made Clear

LOOK at the surface of a pond ruffled by the wind, and you see that it is constantly changing. Its aspect is different in each two successive seconds, and yet after an hour of this perpetual change, the pond looks just as it did when you began to observe it. Ceaseless change here produces nothing new; when the wind dies down in the evening the pond is no different than it was in the calm before dawn.

But ever since men began to leave their thoughts on record, they have made note of the fact that this is not the most usual sort of change. Thinkers have recognized that everything is changing, and that when a living thing changes, it usually becomes something different from what it was before. They have watched the progressive change of a seed to a full-grown plant, of an egg to an adult bird; and men with a historical viewpoint have noted that similar changes occur in institutions and in nations, a small beginning leading through a long series of changes to a new condition, where differentiation took the place of the original simplicity. Greek and Hindu speculators surmised that this condition of progressive change applied to species of animals and plants, one following another, so that from simple beginnings complex creatures finally developed.

This idea of progressive change, of development and differentiation, is the idea of evolution. There is nothing new about the idea—it is not at all a product of modern science. As a philosophical speculation it has existed certainly for several thousands of years, and many attempts have been made to convert it from a pure speculation into a demonstrated theory.

During the past century, the attempt to find an explanation of the way in which evolution might take place has been more persistent than ever before. Four main lines of speculation may be distinguished.

FOUR HISTORIC EXPLANATIONS

1. It has been suggested that the environment acts directly on living creatures and causes changes in them. This view was elaborated about the beginning of the last century by Geoffroy St. Hilaire. He assumed that as the surroundings of a plant or animal change, the plant or animal itself must of necessity respond by a change. He did not assume that the response to the new environment was always a favorable one or, as we say, an adaptation. If it was unfavorable, the individual or the race died out. If it was favorable, the individual or race was able to meet the requirements of its changed surroundings, and survived.

St. Hilaire was unable to secure general acceptance of his theory, because he offered no adequate proof that things ever happened as he described them; yet his conception of evolution contains elements that form the background of our thinking today, and within the last few years his explanation has been revived in a mystical form by the French philosopher Bergson, who has secured for it a certain popularity among laymen—not among biologists.

2. The second of the four great historical explanations appeals to a change not immediately connected with the outer world, but to one within the organism itself. It suggests that any organ or structure of an individual that is much used will increase in size and strength, and this increase will be transmitted to the individual's descendants. Similarly, it is supposed that disuse will

THE GREATEST CONTRIBUTOR TO GENETICS

Around any decaying fruit may be found little red-eyed flies, about one-eighth of an inch long, which are known to science under the name of Drosophila. They are so insignificant that the housewife regards them as hardly even a pest; but to a geneticist they are perhaps the most important insect in the world, for their study has thrown more light on heredity than has that of any other one animal. They are, in fact, practically an ideal subject for study, since they stand confinement well, can be kept indefinitely in a milk bottle with a little overripe banana, and in ten days a single pair of parents will produce a generation of 200 or 300 young. Further, they have a number of well-defined characters that can be followed in heredity, and the number of chromosomes is conveniently small (four). Although geneticists have been searching for ten years to find another equally satisfactory insect, they have failed. Photomicrograph by John Howard Paine. (Fig. 7.)

bring about a decrease in size or strength which will likewise be inherited. This theory of the inheritance of the effects of use or disuse—of the inheritance of acquired characters, to use the customary title—is associated principally with the name of the French zoölogist, Lamarck. It was accepted by Darwin, who made much use of it. It held until a generation ago, when August Weismann discredited it by an appeal to common sense. Today the theory has few followers amongst trained investigators, but it still has a popular following that is widespread and vociferous.

3. There is a third explanation of evolution which has taken protean forms. At one extreme it is little more than a mystic sentiment to the effect that evolution is the result of an inner driving force. The earliest name of prominence associated with it is that of Nägeli; recently the geneticist, William Bateson, has put forward a theory of evolution of somewhat similar nature. The numerous theories of this type may be collected under the title of "The theory of the unfolding principle."

NATURAL SELECTION

4. Darwin and Wallace put forward the last of the great historical speculations about evolution in the well-known theory of natural selection, and the former brought together so much evidence as to win almost universal support from men of science. He appealed to *chance variations* as supply-

ing evolution with the material on which natural selection works. If we accept for the moment this statement as the cardinal doctrine of natural selection it appears that evolution is due (1) *not* to an *orderly* response of the organism to its environment, (2) *not* in the main to the activities of the animal through the use or disuse of its parts, (3) *not* to any innate principle of living material itself and (4) above all *not* to purpose either from within or without. Darwin assumed that small variations are constantly appearing in a species, and that individuals with favorable variations survive and transmit them to their descendants, those with unfavorable variations perish.

Darwin's original contribution was not to demonstrate that evolution existed. That fact had long been recognized in speculation and later received overwhelming proof from comparative anatomy, embryology, paleontology and breeding. All of this evidence showed that living species were related to each other, that they had so much in common as to force the assumption that they came from common ancestors; and paleontology was even able to bring forward some of these common ancestors.

The question was not to show that divergent forms had a common origin, but to explain how they had come to diverge, and Darwin's explanation of the action of natural selection on inheritable variations was generally accepted as accurate. But his attempts to explain (1) the origin of these variations and (2) the manner in which they were inherited met with little success, and as long as these two problems were unsolved, the evolutionist was on uncertain ground.

RECENT PROGRESS GREAT

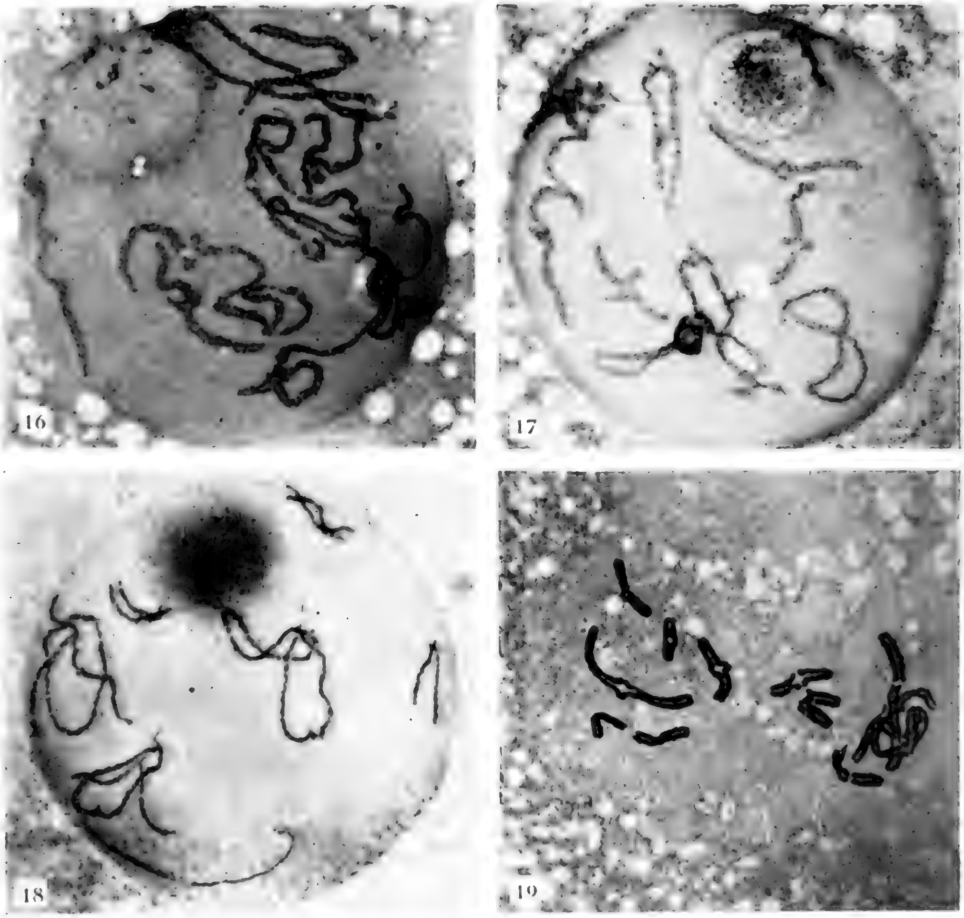
Biologists, therefore, made a widespread attack on these two problems, and it is the belief of many that within the last decade (2) has been explained and (1) has been considerably elucidated, although not yet solved.

This is the viewpoint taken by Prof. Thomas Hunt Morgan, of Columbia Univeristy, who has brought together in book form[1] four lectures in which he critically examines the theory of evolution. In addition to its intrinsic merits, the book has added interest because, in the first place, Dr. Morgan was one of the first zoölogists successfully to challenge the adequacy of Darwin's explanations, and still more, in the second place, because his own work has been very largely responsible for clearing up problem (2) above-mentioned, the problem of how variations are inherited. The book is simply written, and furnishes the first authoritative account of Morgan's work which is available to anyone but the specialist, Morgan's previous works having been too technical for comprehension by the reader who had no previous knowledge of genetics.

The preceding paragraphs have summed up Morgan's statement of the case. We have evolution as a theory, many attempts to demonstrate it, and finally general agreement that Darwin had demonstrated it successfully. Then we see certain fundamental parts of Darwin's proof challenged and, by many critics, thrown out of court. The questions of (1)how variations originated and(2) how they were inherited had to be attacked again, and they were fundamental to the problem. Dr. Morgan's book is mainly devoted to an explanation of his views on these two points.

We can dispose of the first of these points quickly, for the problem it presents has not yet been solved. Darwin borrowed Lamarck's view, that variations originated through the activities of the animal, and whatever could not be explained by this he admitted to be

[1] A Critique of the Theory of Evolution, by Thomas Hunt Morgan, professor of experimental zoölogy in Columbia University. Lectures delivered at Princeton University in February and March, 1916. Pp. 197, price $1.50. Princeton University Press. The book is lavishly illustrated with 95 figures, but many of them are hackneyed or inartistic. Someone could perform a great service to evolutionists by getting together a new set of illustrations to take the place of those that have been doing duty so long.



THE CARRIERS OF HEREDITY

Many different lines of study have made it seem probable that much, at least, of the heredity of an animal or plant is carried in the nucleus of the germ-cell and that in this nucleus it is further located in little rods or threads which can be easily stained so as to become visible, and which have the name of chromosomes. In the above illustration four different views of the nucleus of the germ-cell of an earthworm are shown, with the chromosomes in different stages: in section 19 each chromosome is doubled up like a hairpin. Study of the fruit-fly Drosophila has made it seem probable not only that the hypothetical factors of heredity are located in the chromosomes, but that each factor has a perfectly definite location in its chromosome; and Dr. Morgan and his associates have worked out an ingenious means of measuring the distance from either end, at which the factors lie. Photomicrograph from Foot and Strobell, Archiv. f. Zellforschung V, pl. xii. (Fig. 8.)

at that time unexplainable. We have now thrown out the Lamarckian view, and if we have not been able really to explain how variations arise, we have at least, Dr. Morgan thinks, a truer view of what happens. His discussion of this subject is perhaps the least satisfactory part of the book, but his position is clear enough, being based on the developments of Mendelian heredity.

NATURE OF VARIATIONS

Darwin thought of the individual as a unit, which was undergoing variations in all parts. As a result of experimental breeding, Dr. Morgan says, we must now

abandon this view. The animal itself is not the unit which varies; the germ-plasm of the animal is what varies, and the animal (or plant) is merely the product of (hypothetical) germinal factors. The importance of this change in viewpoint may not be apparent at first sight, but in practice it is found to be weighty, for it substitutes precision and clarity of thought for a wholly mystical idea, and enables us to breed understandingly.

Morgan quotes many instances of variation in the fruit fly Drosophila, on which his work for the last ten years has been mostly based. It is a variable creature; if we catch a bottle full of the same species, we will find that in details they offer numerous differences, and if we go on to breed them we will find that many of these differences are passed on to their progeny. These differences are further found to be inherited in what is known as Mendelian fashion, with which the reader is doubtless familiar.

The point of interest is that every once in a while a fly is born with some character different from the corresponding character of his parents. The parents had normal wings, for example, the offspring comes into the world with extra long wings, and this extra length is found to be inherited in a very definite way.

It is further discovered as the result of long, careful, and widespread observation (Morgan and his associates and students have bred more than half a million flies altogether) that with this change in wing-length go certain other changes in the fly. A change, a variation, seems never to affect one part of the fly alone; it has an indefinitely large number of effects in various parts of the body (and, must we not suppose, on the "mind," too?).

To be strictly accurate, then, we should not say that a certain variation affects length of wing, but that its *chief* effect is to lengthen the wing. "For example, a mutant stock called rudimentary wings has as its principal characteristic very short wings. But the factor for rudimentary wings also produces other effects as well. The females are almost completely sterile, while the males are fertile. The viability of the stocks is poor. When flies with rudimentary wings are put into competition with wild flies relatively few of the rudimentary flies come through, especially if the culture is crowded. The hind legs are also shortened. All of these effects are the results of a single factor-difference.

BY-PRODUCTS OF VARIATION

"One may venture to guess that some of the specific and varietal differences that are characteristic of wild types and which at the same time appear to have no survival value, are only by-products of factors whose most important effect is on another part of the organism where their influence is of vital importance."

"I am inclined to think that an over-statement to the effect that each factor may affect the entire body, is less likely to do harm than to state that each factor affects only a particular character. The reckless use of the phrase 'unit character' has done much to mislead the uninitiated as to the effects that a single change in the germ-plasm may produce on the organism. Fortunately, the expression 'unit character' is being less used by those students of genetics who are more careful in regard to the implications of their terminology."

Now to sum up the new view of the problem of the nature and origin of variations, which Darwin failed to solve. As to the actual cause of these changes in the germ-plasm, we know no more than he did; we suppose them to be chemical reactions. But as to their effects, as to what variation actually means, we have learned a great deal. We have found out that the germinal differences of an individual are inherited separately from each other; that every change in the germ-plasm—*i. e.*, every variation—affects not one but a large number of characters; and conversely, of course, that every visible character is the result of the concurrent action of a large number of factor-differences or variations. It has likewise been demonstrated in many cases

that these variations are inherited in a perfectly definite and predictable way, in accordance with the laws of Mendel.

If the problem of the origin of variations has not actually been solved, we at least have reached a much more exact comprehension of it. We have learned that the animal's own activities can not be invoked to account for variations, and that the environment's direct action cannot explain them. We have seen them to be due to changes in the structure of the germ-cell. It is not certain that we can produce experimentally a single inherited variation—our knowledge is, therefore, much lacking; but the investigators can certainly "report progress," even though it be mainly of a negative kind.

If we turn to the second of the great problems, namely, the way in which variations are transmitted, the nature of the mechanism of heredity, we get a more favorable report. Here are Dr. Morgan's own words:

"THE PROBLEM OF HEREDITY

"I have passed in review a long series of researches as to the nature of the hereditary material. We have, in consequence of this work, arrived within sight of a result that a few years ago seemed far beyond our reach. The mechanism of heredity has, I think, been discovered—discovered not by a flash of intuition but as the result of patient and careful study of the evidence itself.

"With the discovery of this mechanism I venture the opinion that the problem of heredity has been solved. We know how the factors carried by the parent are sorted out to the germ cells. The explanation does not pretend to state how factors arise or how they influence the development of the embryo. But these have never been an integral part of the doctrine of heredity. The problems which they present must be worked out in their own field. So, I repeat, the mechanism of the chromosomes offers a satisfactory solution of the traditional problem of heredity."

It is not necessary here to describe this mechanism in the germ-cells, for an account of Dr. Morgan's work on it was presented in the JOURNAL OF HEREDITY only a few months ago.[2] The germ-cells contain little rods of easily stained material to which the name of chromosomes has been given, and changes that occur in the composition of these rods seem to result in the end-effects which are seen in characters of the animal or plant.

In his last chapter, Dr. Morgan returns again to the doctrine of natural selection, Darwin's principal contribution to the problem of finding how evolution takes place. "In his great book on the *Origin of Species* Darwin tried to do two things: first, to show that the evidence bearing on evolution makes that explanation (*i. e.*, evolution) probable. No such great body of evidence had ever been brought together before, and it wrought, as we all know, a revolution in our modes of thinking.

"Darwin, also, set himself the task of showing *how* evolution might have taken place. He pointed to the influence of the environment, to the effects of use and disuse, and to natural selection. It is to the last theory that his name is especially attached. He appealed to a fact familiar to every one, that no two individuals are identical and that some of the differences that they show are inherited. He argued that those individuals that are best suited to their environment are the most probable ones to survive and leave offspring. In consequence their descendants should in time replace through competition the less well-adapted individuals of the species. This is the process Darwin called natural selection and Spencer, the survival of the fittest."

OBJECTIONS TO DARWIN'S VIEWS

The objections to it, Dr. Morgan says, are (1) that selection can not actually produce anything new and (2) that selection after a while loses its effect. These objections open up controversies which cannot here be pursued. Adopting for the moment Dr. Morgan's views, "The question still remains:

[2] See "Mendelism up-to-date," a Review of "The Mechanism of Mendelian Heredity," by Morgan, Sturtevant, Muller and Bridges. JOURNAL OF HEREDITY, Vol. VII, pp. 17-23, January, 1916.

Does selection play any rôle in evolution, and, if so, in what sense? Does the elimination of the unfit influence the course of evolution, except in the negative sense of leaving more room for the fit? There is something further to be said in this connection, although opinions may differ as to whether the following interpretation of the term 'natural selection' is the only possible one.

"If through a mutation a character appears that is neither advantageous or disadvantageous, but indifferent, the chance that it may become established in a race is extremely small, although by good luck such a thing may occur rarely. It makes no difference whether the character in question is a dominant or a recessive one, the chance of its becoming established is exactly the same. If through a mutation a character appears that has an *injurious* effect, however slight this may be, it has practically no chance of becoming established.

"If through a mutation a character appears that has a *beneficial* influence on the individual, the chance that the individual will survive is increased, not only for itself, but for all of its descendants that come to inherit this character. It is this increase in the number of individuals, possessing a particular character, that might have an influence on the course of evolution."

If the word *variation* be substituted for the word *mutation* in the preceding three paragraphs, the statement would appear to be a good outline of Darwin's own position. The question of how much Morgan's view differs from Darwin's is, then, a question of the difference between Darwin's *variations* and Morgan's *mutations*. To the reviewer, the difference appears one rather of words than of facts. The mutations in Drosophila, which Morgan describes at some length, are many of them exactly the kind of changes which Darwin described as variations.

A DIFFERENCE OF WORDS

If this is a fair statement, then Darwin's work has not been supplanted to anything like the extent that is sometimes supposed. A decade ago, when the mutationists were young and enthusiastic, they gave the impression that they were about to make a great change in the status of natural selection. Darwin's variations were challenged as not being inheritable (as a fact, many of them were not) and mutations were put forward as the real basis of evolution. After ten years of study, it appers that mutation and variation mean practically the same thing. A lot of mere fluctuations have been thrown out, but the concept of mutations as described by Dr. Morgan, while more definite, is not radically different from that of variations which Darwin recognized. That the two parties should now stand so nearly on common ground (whether they recognize it or not) argues well for the validity of the ideas they hold.

Next, does selection of a certain kind of variations lead to the probable appearance of further variations *in the same direction*? Dr. Morgan thinks not. The only rôle of selection is to multiply the numbers of some favorable variation, thus giving it a chance to become established and crowd out the older forms. His conclusion follows:

"The evidence shows clearly that the characters of wild animals and plants, as well as those of domesticated races, are inherited both in the wild and in the domesticated forms according to Mendel's Law.

"The causes of the mutations that give rise to new characters we do not know, although we have no reason to suppose that they are due to other than natural processes.

"Evolution has taken place by the incorporation into the race of those mutations that are beneficial to the life and reproduction of the organism. Natural selection as here defined means both the increase in the number of individuals that results after a beneficial mutation has occurred (owing to the ability of living matter to propagate), and, also, that this preponderance of certain kinds of individuals in a population makes some further results more

probable than others. More than this, natural selection cannot mean, if factors are fixed and are not changed by selection."

Most Mendelians would accept Dr. Morgan's statement as their own. Parts of it would be seriously questioned by other geneticists and by many zoölogists and botanists and all biometricians. But these parts are minor ones, and the essential differences between these various workers appear to be somewhat exaggerated by the use of different names for the same thing.

DARWIN NOT DISCREDITED

If so, it follows that natural selection stands in almost the position where Darwin left it. It is still the only acceptable account of how adaptation takes place, unless one is content to accept a mystical explanation. The past half century has seen the elimination of many false hypotheses; it has brought a clearer idea of the nature of variations and a great increase in the knowledge of how they are inherited; but back of all this is Darwin's principal work—the hypothesis of natural selection—which is substantially confirmed. The reviewer is unable to avoid the conclusion that Dr. Morgan exaggerates the differences between the Mendelian view and the original Darwinian view. Fifteen years of Mendelism have brought much increase of knowledge, and this knowledge has made many ideas of evolution clearer; but it does not seem materially to have changed the theory of natural selection which Darwin built up. As far as the evidence goes, we must still look on evolution as due to the action of natural selection on variations (or mutations), although we have a much clearer idea of the nature of these, and the mode of their inheritance, than was possible to the last generation.

An Early Apostle of Seed Selection

Seed selection is one of the methods most insisted upon nowadays for the improvement of the yield of maize; but the principle involved is not new. The Indians understood and practiced it even in pre-Columbian days. A. D. Shamel has called the attention of this Journal to "Poor Richard's Almanack" for 1812, in which Evan Evans of Washington, D. C., describes the "improved mode" by which he secured from 1 acre of ground, which had not been in cultivation for twenty-five years before, 110 bushels of maize, besides 4 bushels of beans and a quantity of turnips which sold for $16. He lays the most stress on the selection of proper seed, and says that by choosing the largest and fullest ears from the largest stalks he "improved some of the corn from eighteen to thirty-two rows on the ear."

Supposed Degeneration of Vegetables in the Tropics

It is widely believed that northern strains of vegetables, when planted in the tropics, soon deteriorate or "run out." The Porto Rico experiment station has made some tests of this, and reports its results in Bulletin No. 20. It is true that northern vegetables sometimes fail to set seed; in other cases, they are not so well adapted to tropical conditions as are the tropical races; again, they may be planted at the wrong season; finally, the seed loses viability rapidly in the moist, warm atmosphere. All these factors combine to foster the idea that strains of vegetables degenerate; but that such degeneration actually takes place, does not appear from the Porto Rico experiments with peppers, tomatoes, beans, okra and lettuce. Beans of the ninth generation and okra of the eighth were in no way inferior to the first generations.

THE BEST PAPAWS

Superior Fruit Found as the Result of Association's Offer—The Largest Trees —Importance of Proper Maturity of Fruit—Choice Varieties Merit Wide Dissemination

THAT the North American papaw (*Asimina triloba;* not related to the Central American papaya, which is sometimes called papaw) is a more promising fruit than even its admirers have believed, is the opinion of all those who have seen the material sent to the American Genetic Association during the past fall. Better fruits have been discovered than most horticulturists thought possible, and no great difficulty has been found in shipping them. It is hoped that the discovery of these superlative varieties of papaw will lead to their widespread propagation and dissemination.

It will be recalled that the association last spring was enabled, through the generosity of one of its members, to offer a reward of $50 for the photograph of the largest papaw tree and a similar reward for the best papaws. This offer does not expire until January 1, 1917, but as the papaw season is now well past, and contributions have ceased, there seems no impropriety in printing, at this time, the results.

Seventy-five samples of fruit were received, the first on August 18, from Rockway, Tenn., and the last on October 23, from Purcellville, Va. From letters of correspondents it appears that the season extends nearly three months, *i.e.*, from before August 1 to late October.

Reports of 230 different stations of the tree were sent in. They cover almost the whole of the recognized range of the species, as may be seen in the attached map (Fig. 11). It is clear that the tree will succeed in a very large part of the United States.

The best fruit received is considered to be that sent by Mrs. Frank Ketter, of 615 S. Sixth Street, Ironton, Ohio, on September 9. The three largest of the eight fruits weighed 10, 10 and 12 ounces. The latter is the largest size reached by any fruit which the association has received. Numerous reports have been made of fruits that weighed a pound, or even more, but none such was seen by this association. All correspondents agree that the past summer was particularly unfavorable to the development of the papaw in the middle west, because of the long drought, and this may be responsible for the fact that no fruit larger than 12 ounces in size could be secured.

CHARACTERS OF A GOOD FRUIT

Mrs. Ketter's fruit, packed in excelsior, arrived in perfect condition, and had matured very evenly. The skin is comparatively tough and thick and does not discolor markedly; the flesh is medium yellow in color, mild but very rich in flavor, neither insipid nor cloying. The amount and quality of the flesh, together with the good shipping and ripening qualities of the fruit, make this an extremely desirable variety and Mrs. Ketter will be paid the $50 offered for the best fruit. She writes as follows:

"The papaws that you received from me in September were grown in dense thickets consisting of locusts and mulberry trees, and it was impossible to get a good photograph of the tree itself while the foliage was on, for which I was very sorry, as I wanted to try to get *one* of the prizes at least, as I felt that these papaws were the finest around here and so many that go up to our place want to buy some to send to their friends, as they claim they never saw such fine ones.

"The tree is wild, receives *no* attention whatever, and bears well every year. As this tree from which that

THE LARGEST PAPAW TREE

Most people know the papaw only as a shrub, but in this specimen it reaches a really respectable size; and a few other trees not much smaller have been found. The tree above appears to be slowly dying, possibly of old age. But a number of instances have been found where the papaw has borne fruit regularly for sixty or seventy years, and no one knows how much longer. The idea that it is a short-lived tree seems, therefore, not to be wholly true. Photographed near Boonville, Ind., in August, 1914, by C. P. Close. (Fig. 9.)

fruit was taken grows in a thicket it does not have the spread it should.

"The tree bears one-half to 1 bushel and bears annually.

"At the base it measures from 6 to 8 inches in diameter and about 20 feet in height.

"Plenty of twigs could be obtained for grafting and a great number could be obtained for transplanting of smaller trees growing in this thicket which bear the same quality of fruit as I sent you.

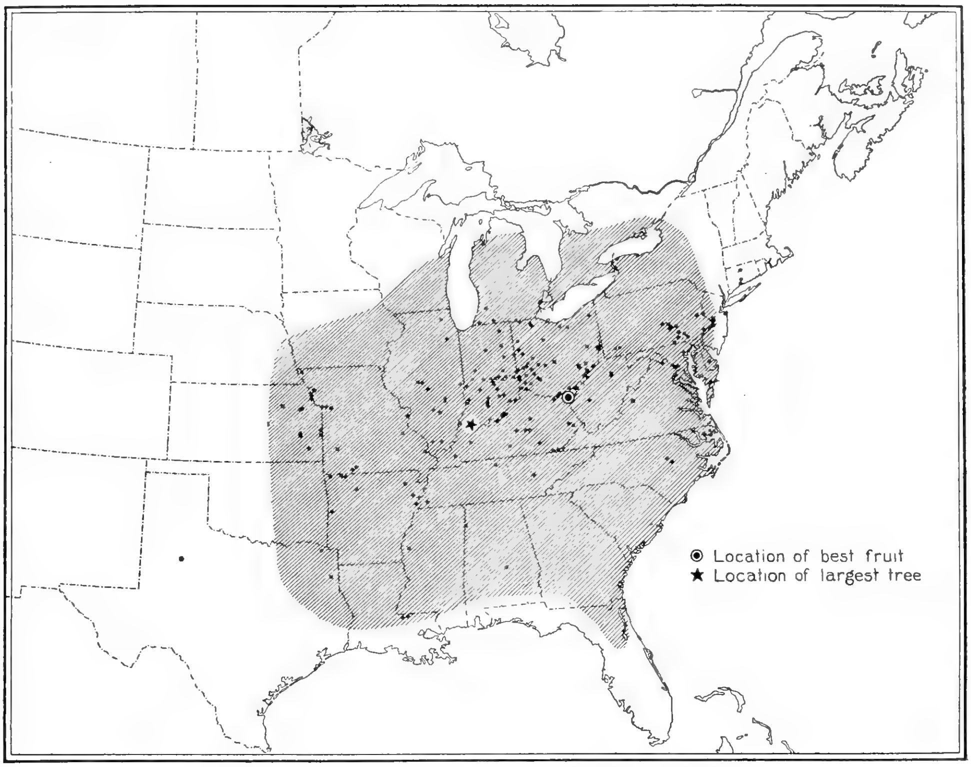
"This tree is located on the hills of Lawrence County in Fayette Township in the most southern point of Ohio."

Six other samples of fruit stood out above all the rest in quality, and are worthy of propagation. They were sent by the following:

John Cheatwood, Gallia, Ohio, September 12. Weight, 10 to 12 ounces. These fruits, whose yellow flesh was very mild and good, came from one of a cluster of four trees about twenty-five years old which, Mr. Cheatwood says, all bear fruit of the same quality, that in most years reaches a much larger size than the above. The group bore about 2 bushels of fruit this year.

S. C. Martin, R. F. D. No. 9, Springfield, Ohio, September 19. Weight 10 to 11 ounces. Flesh yellow and of superior quality, seeds not large, skin tough. Fruit arrived in perfect condition and matured evenly.

William Rees, Jr., R. F. D. No. 3, Pleasanton, Kans., September 19. Weight 8 to 9 ounces. Flesh pale yellow and of good flavor, seeds excep-



RANGE OF THE PAPAW IN NORTH AMERICA

The range shown by shading is that established by the U. S. Forest Service on the basis of all available previous information. Correspondents of the American Genetic Association have contributed about 230 new stations, which are shown by dots on the map. They cover almost every portion of the accepted range, but only in a few cases go beyond it. The absence of reports from some parts of the range may show that the papaw does not grow to perfection there, or it may merely show that the offer of the association was not widely advertised in those regions. Map prepared by the courtesy of the Forest Service. (Fig. 11.)

tionally small. Although not a large fruit, this ships well and has good quality. They come from two trees in the bend of a creek, on "made soil."

Edward Oswald, Hagerstown, Md., October 2. Weight up to 11 ounces. Flesh yellow, flavor good; shipped well and matured evenly. These fruits were grown on a tree which Mr. Oswald transplanted from the woods to his farm, and to which he has given some care.

Dr. B. S. Potter, Julietta, Ind., October 5. Weight 7 to 8 ounces. Although a small fruit, this one has a mild and satisfying flavor, and ships fairly well; it is also late in maturing, which may be an advantage commercially. Flesh a rich yellow in color. Dr. Potter writes that he had one fruit this year which weighed 14 ounces, and adds, "In 1911 I produced three papaws in one cluster, each weighing slightly more than 1 pound. I have more than an acre of papaw trees, from 6 to 10 inches in diameter, and all, save one, bearing fruit of the variety sent you. This grove produces annually from 15 to 25 bushels. It is not an uncommon thing to gather 3 bushels of a morning. They begin ripening as early as August 6. My trees have not missed bearing in abundance for the last seven years. In 1911 I sent 2

THE LARGEST WILD FRUIT IN NORTH AM

The papaw produces, even in the wild state, an occasional fruit which compares favorably with ou
papaw, as the cultivated apple is than a wild crabapple. The original wild apple was probal
tors, and the same holds true of most of our cultivated fruits. The papaw has had no sys
suppose that a little attention from horticulturists would result in the production of a
members, to locate a number of the best trees in the country, with the hope that fruit gro
thick enough skin to ship well. They have a mild and seductive flavor, with the characterist
that temperate-zone pomology can furnish. Cultivation may be expected to improve the
probable that the size of the fruit can be still further increased, since specimens have often b
to have been too dry to bring out these large fruits. A good tree should bear from 50 to 1
the Office of Foreign Seed and Plant Introduction, U. S. Department of Agriculture. (Fi

:A, YET ALMOST UNKNOWN TO HORTICULTURISTS

ıg-cultivated European fruits. The fruits from these desirable trees are as much better than the common
uch inferior to even the crabapples we know today. The pear is an equally great improvement on its ances-
:ic improvement and yet produces such fruit as that shown, natural size, above. Is it not reasonable to
inctly superior fruit? This association believes so and has been able, through the generosity of one of its
will propagate these good strains by grafting. These best fruits are not only large and meaty, but have a
ıaw aroma, but not to an excessive degree; eaten with sugar and cream they offer one of the richest dishes
qualities of the fruit, and lessen its defects, reducing the number and size of the seeds, for instance. It is
eported which weighed a pound—*i. e.*, a third as much again as the above, although the past summer seems
ıits like the above, regularly every year, beginning three or four years after it is set out. Photograph by
:)

TRUNK OF THE GREAT PAPAW

Close view of the prize-winning specimen near Boonville, Ind., showing characteristics of the species. Dendrologists agree that the wood of the papaw is light, spongy, and of little value, but it is said to have been somewhat used for building purposes in the southern States. When freshly cut it shows beautiful yellowish and greenish tints, and gives out an easily recognizable odor. Photograph by Thomas P. Littlepage. (Fig. 12.)

bushels to Los Angeles, Cal. They reached their destination in perfect shape. Later I sent several hundred choice papaw seeds to Artesia, Cal., where I now have a fine lot of trees.[1] The trees readily sell at $1 per tree."

J. C. Roach, De Kalb, Mo., October 12. Weight 7 to 8 ounces. This fruit is of unusual shape, very long in proportion to its breadth, sometimes almost like a banana in form. The quality is good, but not equal to that of the others here listed; as a shipper, however, it is perhaps the best of all, the skin being notably tough and thick. The fruits (eighteen in one box) all arrived intact, although they were quite ripe, had been on the road three days or more, and were protected only in a few cases by a light wrapping of tissue paper. Mr. Roach states that his pasture contains eight or ten large trees of this quality, as well as many seedlings, and that he will be glad to furnish seedlings or twigs to those who wish to propagate the variety.

Most of the papaws received came from wild trees or bushes, but a few people have already taken up the cultivation of the fruit. Benjamin Buckman, of Farmingdale, Sangamon County, Ill., sent a box with a number of named varieties from his grove, as follows:

Cheeley, secured from and named after Jefferson Cheeley of Iuka, Ill.

Hann, from Arkansas.

Early Best, secured from W. C. Stout of Indiana.

Arkansas Beauty.

Scott, secured from C. S. Scott of West Virginia.

Endicott, from George Endicott, Villa Ridge, Ill.

Hope's August, from Anthony Hope of Paint, Ohio.

Hope's September.

Uncle Tom, from J. A. Little of Cartersburg, Ind. This is probably the first named variety of the papaw on record.

None of these fruits was larger than 7 ounces, and they were not ripe enough to allow a fair judgment of their quality.[2]

The largest tree found by this association is 4 or 5 miles southeast of Boonville, Warrick County, Ind. It was found and described by T. P. Littlepage, of Washington, who also sent photographs of it; but his photographs did not comply with the conditions of the association's offer, as they did not show the tree in foliage. C. P. Close, of the Bureau of Plant Industry, Washington, had a photograph of the same tree in full foliage, which he submitted at the request of Mr. Littlepage and, with the consent of the latter, the $50 to be paid for the largest tree will go to Prof. Close.

Ordinarily the papaw does not reach a larger diameter than 1 foot. This specimen, shown in Figs. 9 and 12, is 6 feet 6 inches in circumference at the base, 5 feet in circumference at 3 feet above the ground, and 25 feet high. It appears to be dying now, although it still bears a few fruits; Mr. Littlepage attributes its decline to the fact that the pasture in which it stands is growing up in blue-grass sod. He states that a still larger tree, 5 feet in circumference shoulder high, is lying on the ground near it, having been blown down a few years ago; and he mentions another flourishing tree northeast of Boonville which he says is about 4 feet in circumference.

Other good records were sent in by:

George Yaeger, Salamonia, Jay County, Ind., 40 inches in circumference.

George W. Harp, New Paris, Preble County, Ohio, 40½ inches at 20 inches above the ground.

William D. Hewitt, 671 Bullit Building, Philadelphia (tree at Burlington, N. J.), 38 inches at 2 feet above ground.

J. C. Roach, De Kalb, Mo., 38 inches at 4 inches above ground.

[1] G. P. Rixford, of San Francisco, states that he has found bearing papaw trees at Santa Barbara, Loomis, Berkeley (University grounds), Miller and Lux Ranch, Forest Ranch P. O. (near Chico), and Coloma (Sutter's Mill, where gold was first discovered), in California, and that some of these fruits seem to him of better quality than any eastern papaws he has eaten.

[2] Mr. Buckman's orchard contains altogether twelve named varieties of papaw. In addition to those above mentioned, he enumerates Cox's Favorite, Early Cluster, and Propst Early.

THE PAPAW RAPIDLY SPREADS

Whether planted or wild, the papaw spreads rapidly by means of suckers from the roots, which sometimes prove to be a great nuisance. At the right of the above tree, near the corner of the shed, can be seen a number of these suckers. If unmolested they will soon form a thicket, as shown in the succeeding illustration. The tree above is located near Maytown, Lancaster County, Pa., and is about 35 years old. It measures 35 inches in circumference at 2 feet from the ground and bore 1½ bushels of fruit last August. Photograph from Mrs. Joseph P. Draper. (Fig. 13.)

F. C. Jordan, Allegheny Observatory, Pittsburgh, Pa., 35 inches.

Helen L. Trice, R. F. D. No. 7, Heltonville, Ind., a double tree which measures 62 inches in circumference at 6 inches above ground. One fork is 37 inches in circumference, the other 33. It is not clear from the photograph whether this represents one tree which has forked, or two trees which have grown together.

The wood is light yellow, with a specific gravity of only about 0.40. Dendrologists invariably describe it as weak, soft, and worthless, but W. T. Coleman, of Bono, Ark., writes that he knows of a house in which all the rafters and joists are made of papaw, and that in earlier times it was much used for barn logs. The inner bark is said to have been used for making nets.

LIFE OF THE TREE

The tree is generally described as short lived. W. D. Hewitt believes that the trees on his property at Burlington, N. J., are at least 80 years old. "I know of one patch," says R. R. Bane, of Wellsburg, W. Va., "the trees of which must be nearly 100 years old, as I am 59 myself and the trees were large when I was a boy." James

Mooney, of Martinsville, Ohio, says, "I know some trees about here that are 8 or 9 inches in diameter, the owner of which tells me he gathered papaws from them sixty years ago, and they look as though they might live sixty years longer." Mr. Mooney continues:

"We have several distinct varieties growing about here: the small early yellow, the large oblong yellow and several kinds of large white papaws. The little yellow will be ripe in a few days or about the twentieth or twenty-fifth of August, while others will not be ripe until September, October and as late as the latter part of November—in fact I have found good papaws under the leaves as late as December.

"We live on one of those beautiful ridges or watersheds that separate the white swamps from the highlands. Papaws will not grow in the swamps with the exception of the foothills of creeks and rivers. It seems to prefer the uplands where grow sugar trees and black ash, and in the kind of soil that supports May apples and ginseng—a rich, brown loam with a good covering of leaf mold. The papaw is one of the slowest growing trees I ever saw and is inclined to be a little cowardly when growing in company with other forest trees that crowd it out or shade it too much. It will thrive better in thin woods where all other underbrush has been cut out, and where the overhanging boughs do not interlace and cut out the sunlight. I do not know of any insect that destroys the papaw tree and none that attacks the fruit except the little black and yellow beetle that bores into the fruit after it has fallen to the ground; and I believe that I know of no animal except man and the opossum that would eat a papaw—with the exception of a small rat terrier dog that follows me in my rambles in the woods and meadows; I do not believe he eats them because he has any particular love for them but just to show his faith in me, as he eats only those I give him.

"Here are some things to remember when planting papaw seed: that it is one of the most tender and brittle trees and needs a good windbreak to parry off the wind storms that will surely come and strip it of branches and foliage; and that the best papaws grow in the richest soil, the primitive soil—I mean the kind of soil where logs have rotted and where the land slopes sufficiently to let the water drain off."

Miss C. V. Krout, of 218 West College Street, Crawfordsville, Ind., adds the following notes:

"In our yard are two groups of papaw trees which have been continually grown for about fifty years. Of course they have died out from time to time, but never all at once, and have renewed themselves by sprouts and seeds. We have never cultivated them, and are of the opinion that pruning and cultivation are hurtful to them.

"The papaw sprouts annoyingly, and in three years these sprouts will bloom, if thrifty, but bear sparingly until about five years old. When they are about twenty they are at their best as producers of fruit. They are the only shrub-tree—if I may coin a name—which has a dark brown bloom, so like the Calicanthus it is often mistaken for it; the bloom of the Indian Arrowwood and the Wake-Robin are of the same color. In the woods about here they grow in deep soil with a carpet of moist leaves around their feet, but ours have a very sunny exposure—in sunlight all the day."

Most of the correspondents grow them from seed, by planting the entire fruit, and then thinning out the less thrifty seedlings. Under favorable circumstances they are reported to bear in the third or fourth year after planting.[3] The yield is variable: one tree is described which was carrying about 400 clusters, with 4 to 6 fruits in a cluster.

[3] Actual commercial plantings of the papaw seem to be few. There is, or was, an orchard of thirty-five trees at Danville, Ind., which the late James A. Little planted for the late Judge John V. Hadley of the Indiana Supreme Court; and an orchard of more than 100 trees belonging to L. Swartz at Charleston, W. Va.

THE PAPAW IN A STATE OF NATURE

Most people know the papaw, not as an isolated tree, but as a shrub growing in dense thickets like the small one above. Such a thicket may start with a single seedling, or all the seeds in one fruit may sprout and grow close together. As the trees grow, they send out suckers from the roots, as shown in the preceding illustration, and so gradually extend their area. From time to time the older trees die, but their places are taken by new ones, so that the thicket rarely diminishes in size, but always tends to enlarge. In some of the southern States tracts of many hundreds of acres are covered by thickets of this character. Usually the closely crowded trees do not bear such good fruit as those that are isolated and have more light; yet the best fruits received by this association came from just such a thicket as that shown above. Photograph made in Lancaster County, Pa., by Mrs. Joseph P. Draper. (Fig. 14.)

A good tree appears to bear 50 to 100 fruits. It is certain that the size of the fruit could be considerably increased if the tree were gone over in the early summer and all the fruits picked off except one in each cluster. At present the sale is local and apparently not great, and the price is low. H. S. Bomberger, of Palmyra, Pa., states, "I always ship the fruit in berry crates in quart boxes and get $5 a bushel for them."

Occasionally some one is found who is subject to poisoning by the papaw. Benjamin Buckman writes, in sending a shipment of fruit, "I had to pack this box in an outhouse, and wash my hands and face thoroughly in soapy water, because one or two in my family are affected by a single ripe papaw in the room, as badly as the most virulent case of poison ivy I have ever seen, and sugar of lead (often used in ivy poisoning) has no effect on the poison what-

ever." Prof. M. A. Barber, of Kansas University, who studied this poisoning, concludes[4] that it is dependent on a constitutional idiosyncrasy, some people being affected by papaws just as some people are poisoned by strawberries, or oysters. The degree of ripeness of the fruit seemed, in his case, to make some difference in the effect. The poison appears to be in the skin of the fruit, not in the flesh, and there is no record of unpleasant consequences from eating the fruit, which seems to be of a particularly wholesome character.

All of the fruit received by the association had yellow flesh, but it is certain that white-fleshed varieties exist, as almost every correspondent who has had any extended experience with the papaw mentions them. They are distinguished most clearly by Prof. Stanley Coulter:[5]

"Two forms, not separated botanically, are associated in our area. They differ in time of flowering, in size, shape, color and flavor of the fruit, in leaf shape, venation and odor and in color of the bark. They are of constant popular recognition, never seeming to intergrade." The white fleshed fruit is generally said to be inferior, and this probably accounts for the fact that no such fruits were sent to the association. It is also said by some correspondents to be larger. It is very probably a distinct subspecies, if not a good species. The papaw's genus, Asimina, has not been exhaustively studied, but already six or seven distinct species have been constituted in it. With the exception of the papaw itself, they are all small shrubs. One of them, *A. speciosa* of Georgia and Florida, has an ornamental yellowish-white flower, and might be crossed on the papaw with a view to making the flower of the latter more conspicuous.

In general, it is not certain that much is to be expected from hybridization of the papaw. None of the other members of the genus is of commercial value, and the members of the family, the Annonaceae or Custard Apples, are mostly tropical. Commercially the most promising cross would seem to be with one of the Annonas—the delicious South American Cherimoya, for example, whose fruit sometimes reaches a weight of 5 pounds. But there is a considerable obstacle to the success of this cross, in the fact that the fruit of the papaw is a simple berry, while that of the Annonas is compound by the coalescence of the ripening ovaries. The cross is worth trying, nevertheless, for success would be of great importance. G. P. Rixford reports that the cherimoya has been successfully grafted on papaw roots at Santa Barbara, Cal., and this may make possible an extension of the growth of the Annonas north of their present limits. At present they are hardy only in Southern California and Florida, while the papaw is hardy as far north as the Great Lakes and Connecticut.

At present the papaw seems little used except to eat raw or to make by fermentation a rather bitter beer. Its addition to custard pie produces a satisfactory effect. Dr. C. F. Langworthy, of the U. S. Department of Agriculture, who tested its possibilities, concludes that the best way of treating it is to beat the flesh up with cream. It also makes a delicious ice cream.

It is the opinion of those who have handled the fruits sent to the American Genetic Association, that the papaw's reputation would be much better if it were eaten at the proper stage of maturity. It is by many supposed to be eatable only after it has hung on the tree for some time, when the flesh becomes dark in color and slightly fermented. In this condition, however, it seems to the writer and his associates to be really unfit to eat. The fruits that have given the greatest satisfaction are those that were picked just as they began to soften, and allowed to ripen in a cool temperature. Some that were

[4] Barber, M. A. Poisoning Due to the Papaw (*Asimina triloba*). Journal of the American Medical Association, December 30, 1905.

[5] Report of Indiana State Geologist, 1899, p. 745, quoted in Eleventh Annual Report, State Board of Forestry, Indianapolis, 1912.

THE ORNAMENTAL FORM OF THE PAPAW

When given sufficient space, the papaw heads up into a shapely tree which is an ornament to any lawn. Its large leaves have a distinctly tropical appearance and its flowers, although not conspicuous, are attractive. It is notably free from infestation by insects and little susceptible to plant-diseases. Being hardy over a wide area, it can be strongly recommended for planting wherever room is available. (Fig. 15.)

quite hard when received at this office were placed in a refrigerator and after two weeks were found to be in a perfect condition for eating. It is probable that varieties differ in the evenness of their maturity; but assuming that the variety be a good one, it seems likely that it should be picked before fully ripe and allowed to mature indoors. Experiment would easily determine the proper conditions. Several persons who previously despised the papaw were quite converted when given fruits that were not overripe. If this idea of maturity of the fruit is sound, it offers considerable advantages commercially, since the fruit can be picked and shipped while still firm, and allowed to ripen after its arrival at market.

While hybridization offers some interesting possibilities in improving the papaw and reducing the number or size of seeds, it seems likely that simple selection will give quicker good results. If seedlings or inferior trees are grafted to such superior varieties as are described at the beginning of this article, the esteem of and demand for the fruit should increase rapidly.

Seeds should be planted while fresh, and are excessively slow in growing, sometimes not appearing until a year from the following spring. If given good care they then make fairly rapid growth, and may be transplanted when 12 to 18 inches high. This is preferably done when they are dormant, but has been done successfully when they are in full leaf; the secret is to take up a very large ball of earth around the roots. They should be grafted early in the spring. It is commonly supposed that they thrive best with some shade but a number of experiments show that they do well in full sunlight. The soil should be well drained, and can hardly be too rich. The tree is notably free from diseases and pests, and is desirable for ornamental as well as commercial planting. Its large, dark, handsome leaves make it a striking landscape tree for lawns of considerable size. Planted anywhere within the range shown on the attached map, it should succeed; and if it is grafted to a good variety, given sufficient fertilizer, not allowed to bear too many fruits in a single cluster, and these fruits properly matured, it can hardly fail to please.

A New Text-Book of Genetics

GENETICS AND EUGENICS, a text-book for students of biology and a reference book for animal and plant breeders, by W. E. Castle, Professor of Zoölogy in Harvard University and Research Associate of the Carnegie Institution of Washington. Pp. 353. Illustrations 135. Price, $2.00 net. Cambridge, Mass., Harvard University Press, 1916.

Dr. Castle's book is notable not only because of its contents, but because it is the first comprehensive advanced textbook of genetics in the English language. It contains a general discussion of evolution and the historical explanations of it, devotes a short and somewhat inadequate chapter to biometry, and then discusses Mendelism at length, principally from the animal breeder's viewpoint. Dr. Castle's treatment of all disputed subjects is frankly critical, a fact which adds much to the value of the work; it is also practical, lists being given of the unit characters so far isolated in domestic animals. The treatment of eugenics occupies forty-four pages, is conservative throughout, but particularly sound in its treatment of Mendelism in man. A good bibliography is added, and a reprint of the R. H. S. translation of Mendel's original paper; according to those who have compared this translation with the original, it needs revision. But on the whole the book is admirable both in plan and execution and will be indispensable to every serious student of genetics.

THE GREAT RACE PASSES

Nordic Peoples, Who Have Ruled Occidental World for Many Centuries, Succumbing to War and Competition of Other Races—A Recasting of European History in Terms of Race Instead of Nationality and Language, by Madison Grant

THE "Aryan race" is now extinct. It is only a few years ago that his descent from this great, prehistoric, pastoral race was taught to almost every student in civilized countries. It had been found that people in various parts of Europe and Asia spoke related languages; it was evident that these languages probably derived from a common source, and it was thereupon assumed that the races which spoke them must equally derive from a common source.

With the progress of biology, comparative linguistics is no longer the sole guide to knowledge of the races of man. It is abundantly proved that the various races with Aryan tongues are quite dissimilar, and often have little or nothing in common except their language.

Although the fallacy of the "Aryan race" has vanished, a great number of similar fallacies yet remain. History has rarely been written by biologists: indeed, the biological view of history is the product of only the last few decades. It is not surprising, then, that most readers unconsciously confuse race, nationality and language. Few hesitate to think and speak of the Germans as if they were one homogeneous people. Yet although the Prussian and Bavarian have the same language and nationality, they are much more distantly related than are the Prussian and Scot, or the Bavarian and North Italian.

Now this confusion of thought, and this ignorance of race distinctions, have much more than academic importance; for "race has played a far larger part than either language or nationality in moulding the destinies of men; race implies heredity, and heredity implies all the moral, social and intellectual characteristics and traits which are the springs of politics and government." The idea that nationality and language are the important factors in the classification of men goes with the now discarded idea that changes in the environment will change the inborn nature of men. General adoption of the modern biological viewpoint demands that differences in nationality and language be regarded as secondary and changeable, and that the more permanent genetic differences in race be more carefully studied; and, it may be added, further social progress seems to depend largely on the general adoption of the modern biological viewpoint.

A NEW VIEW OF HISTORY

Such a book as that of Madison Grant[1] on "The Passing of the Great Race" is, then, well worth while. It is "devoted to an attempt to elucidate the meaning of history in terms of race; that is, by the physical and psychical characters of the inhabitants of Europe instead of by their political grouping, or by their spoken language." The book contains little with which specialists are not familiar, but it supplies a readable account of recent work to those who do not follow the publications of specialists. In the field of genetics the author makes some misstatements, but in the field of anthropology he has followed the latest authorities and, although many of the points discussed are still open to contro-

[1] The Passing of the Great Race, or the Racial Basis of European History. By Madison Grant, Chairman, New York Zoological Society; Trustee, American Museum of Natural History; Councilor, American Geographical Society. Pp. 245, 3 charts and 4 maps; price $2.00. New York, Charles Scribner's Sons, 1916.

versy, his guidance is as trustworthy as that of anyone.

He starts as far back as possible.

"Man's place of origin was, undoubtedly, Asia. Europe is only a peninsula of the Eurasiatic continent, and although the extent of its land area during the Pleistocene was much greater than at present, it is certain, from the distribution of the various species of man, that the main races evolved in Asia long before the center of that continent was reduced to deserts by progressive dessication.

"Evidence of the location of the early evolution of man in Asia and the geologically recent submerged area toward the southeast is afforded by the fossil deposits in the Siwalik hills of northern India, where have been found the remains of primates which were either ancestral or closely related to the four living genera of anthropoids; and by the discovery in Java, which in Pliocene times was connected with the mainland over what is now the South China sea, of the earliest known form of erect primate, the Pithecanthropus. This apelike man is practically the 'missing link,' being intermediate between man and the anthropoids. Pithecanthropus is generally believed to have been contemporary with the Günz glaciation of some 500,000 years ago, the first of the four great glacial advances in Europe."

"Man existed in Europe during the second and third interglacial periods, if not earlier. We have his artifacts in the form of eoliths, at least as early as the second interglacial stage, the Mindel-Riss, of some 300,000 years ago. A single jaw found near Heidelberg is referred to this period and is the earliest skeletal evidence of man in Europe."

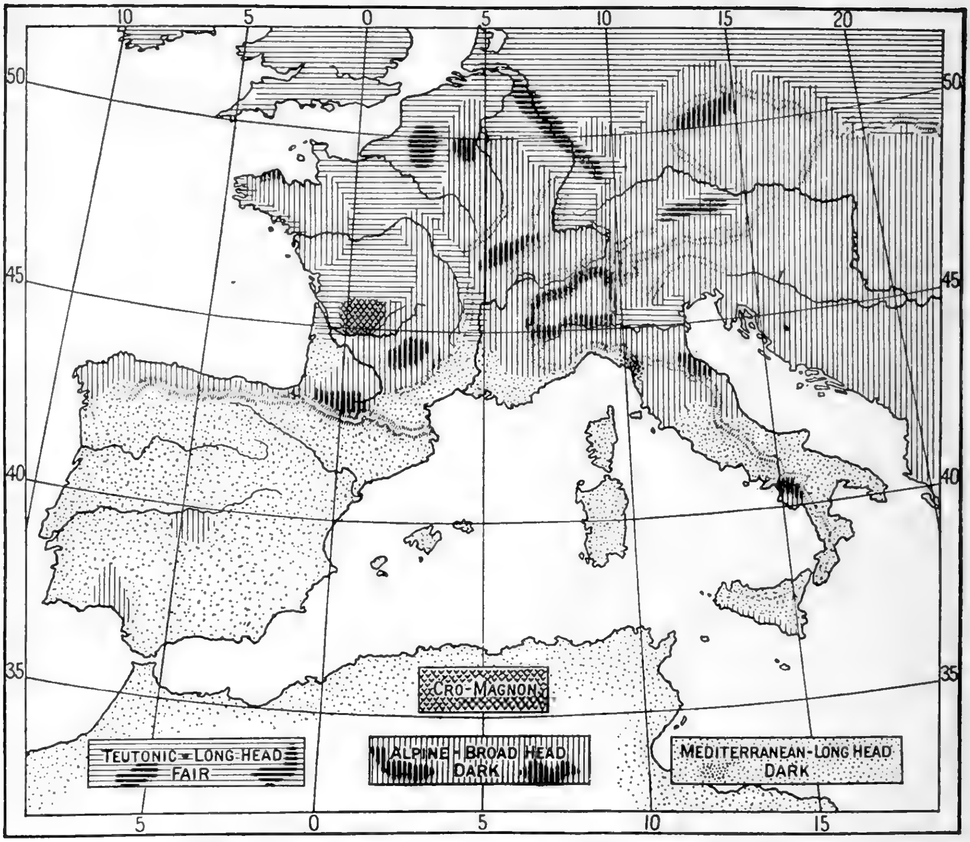
A GREAT PREHISTORIC RACE

These early residents disappeared suddenly from Europe about 25,000 B. C., when they were apparently exterminated by a new and far higher race, the famous Cro-Magnons, who were "of very modern aspect," taller than modern Europeans, and with a greater brain capacity. "The Cro-Magnon culture is found all around the basin of the Mediterranean, and this fact, together with the conspicuous absence in eastern Europe of its earliest phases . . . indicates that it entered Europe by way of North Africa. . . . There is little doubt that the Cro-Magnons originally developed in Asia and were in their highest stage of physical development at the time of their first appearance in Europe." They persisted for about 15,000 years, led the life of huntsmen, had no agriculture or domestic animals, and disappeared from view as the climate became warmer. A number of other races of inferior ability appeared toward the end of this Paleolithic or Old Stone age.

"About 7000 B. C. we enter an entirely new period in the history of man, the Neolithic or New Stone age, when the flint implements were polished and not merely chipped. Early as is this date in European culture, we are not far from the beginnings of an elaborate civilization in parts of Asia. The earliest organized states, so far as our present knowledge goes, were the Mesopotamian empires of Accad and Sumer—though they may have been preceded by the Chinese civilization, whose origin remains a mystery, nor can we trace any connection between it and western Asia." Agriculture now makes its appearance in Europe and, about 4000 B. C., a great advance in the world's civilization was made when some unknown genius discovered that an amalgam of nine parts of copper and one part of tin would make the metal we now call bronze, which was not only easily worked but particularly suitable for tools and weapons. This introduced the Bronze Age in Egypt, where the discovery was made. The people of western Asia acquired superior weapons and soon swept into and conquered Europe, into which territory small numbers of them had apparently been filtering for many centuries.

AN INVASION FROM ASIA

These invaders are nowadays known as the Alpine race. "The western



THE PRESENT RACIAL GEOGRAPHY OF EUROPE

In Central France is a small area where descendants of the great prehistoric Cro-Magnon race are supposed still to survive; but apart from this the region above shown is almost exclusively occupied by three great races, whose distribution is roughly shown by the shading, which is made particularly heavy in the places where the race is purest or most numerous. Unfortunately, the map does not show Scandinavia and the northern part of the German Empire, where the Nordic race, "The Great Race," as Mr. Grant calls it, is purest and most predominant. From H. F. Osborn, Men of the Old Stone Age (New York, 1915). (Fig. 16.)

Himalayas were probably its center of original evolution and radiation, and its Asiatic members constitute a distinct subdivision, the Armenoids.

"The Alpine race is distinguished by a round face and correspondingly round skull which in the true Armenians has a peculiar, sugarloaf shape, a character which can be easily recognized." The Alpines must not be confounded with the slit-eyed Mongols who center in Tibet and the steppes of north Asia. They are "of medium height and sturdy build, both as to skeleton and muscles. The coloration of both hair and eyes was originally very dark and still tends strongly in that direction, but many light-colored eyes, especially gray, are now found in the Alpine populations of western Europe.

"This race in its final expansion far to the northwest, ultimately reached Norway, Denmark and Holland, and planted among the dolichocephalic natives small colonies of round skulls, which still exist. When this invasion reached the extreme northwest of Europe its energy was spent, and the

invaders were soon forced back into central Europe by the Nordics. The Alpines at this time of maximum extension, about 1800 B. C., crossed into Britain, and a few reached Ireland and introduced bronze into both these islands." In Britain, however, they made little permanent mark. At the present time they form the great bulk of the population of central France; they represent the Slavs of the countries to the east—the Czechs, Slovaks, Poles, Serbs, Croats, etc. The Magyars, who now form the dominant party in Hungary, are racially distinct, being an Asiatic group allied to the Turks. Alpines are to be found in large numbers in southern Germany and northern Italy.

The early Alpines brought civilization to Europe, with the culture of the Bronze Age; and in Asia they have to their credit the first real civilizations on record—those of the Tigris and Euphrates valleys. But "in classic, medieval and modern times the Alpines have played an unimportant part in European culture. . . . There are, however, many indications in current history which point to a great development of civilization in the Slavic branches of this race."

AN INVASION FROM AFRICA

These round-skulled Alpines had pushed themselves like a wedge into central Europe. To the north of them were the Teutonic tribes, the Nordic race presently to be described; to the south was the Mediterranean race, which is called Iberian by old writers. This is "a relatively small, light boned, long skulled race, of brunet color, becoming even swarthy in certain portions of its range. Throughout Neolithic times, and possibly still earlier, it seems to have occupied, just as it does today, all the shores of the Mediterranean, including the coast of Africa from Morocco on the west to Egypt on the east. The Mediterraneans are the western members of a subspecies of man which forms a substantial part of the population of Persia, Afghanistan, Baluchistan and Hindustan, with perhaps a southward extension into Ceylon."

"This Mediterranean subspecies at the close of the Paleolithic spread from the basin of the Inland Sea northward by way of Spain throughout western Europe, including the British Isles, and, before the final expansion of the Alpines, was widely distributed up to and touching the domain of the Nordic dolichocephs. It did not cross the Alps from the south, but spread around the mountains across the Rhine into western Germany."

"It is to the Mediterranean race in the British Isles that the English, Scotch, and American owe whatever brunet characters they possess. In central Europe it underlies the Alpine race, and, in fact, wherever this race is in contact with either the Alpines or the Nordics, it appears to represent the more ancient stratum of the population."

"Today the Mediterranean race forms in Europe a substantial part of the population of the British Isles, the great bulk of the population of the Iberian peninsula [Spain and Portugal], nearly one-third of the population of France, Liguria, Italy south of the Apennines, and all the Mediterranean coasts and islands, in some of which, like Sardinia, is exists in great purity. It forms the substratum of the population of Greece and of the eastern coasts of the Balkan peninsula." In Britain the Welsh are the principal representatives of this race.

MAKERS OF CIVILIZATION

"This is the race that gave the world the great civilizations of Egypt, of Crete, of Phoenicia including Carthage, of Etruria and of Mycenean Greece. It gave us, when mixed and invigorated with Nordic elements, the most splendid of all civilizations, that of ancient Hellas, and the most enduring of political organizations, the Roman State."

"Even though the Mediterranean race has no claim to the invention of synthetic languages, and though it played a relatively small part in the development of the civilization of the Middle Ages or of modern times, never-

theless, to it belongs the chief credit of the classic civilization of Europe, in the sciences, art, poetry, literature, and philosophy, as well as the major part of the civilization of Greece and a very large share in the Empire of Rome."

"With the fall of Constantinople [1453 A. D.], the Empire of Rome passes finally from the scene of history, and the development of civilization is transferred from Mediterranean lands and the Mediterranean race to the North Sea and the Nordic race"—the "Great Race" after which Mr. Grant's book is named.

It has been shown that the Mediterranean race came from Asia, via North Africa; that the Alpine race also came from Asia, through Asia Minor and the valley of the Danube. Of the three races which make up practically all of modern Europe, only the Nordic can claim to be indigenous: although its ancestors doubtless came from Asia originally, it has developed its physical characters and its civilization in north Europe. "It is everywhere characterized by certain unique specializations, namely, blondness, wavy hair, blue eyes, fair skin, high, narrow and straight nose, which are associated with great stature, and a long skull, as well as with abundant head and body hair."

HOME OF THE ORIGINAL EUROPEANS

"For the development of so marked a type there is required a continental area isolated and protected for long ages from the intrusion of other races. The climatic conditions must have been such as to impose a rigid elimination of defectives through the agency of hard winters and the necessity of industry and foresight in providing the year's food, clothing and shelter during the short summer. Such demands on energy, if long continued, would produce a strong, virile, and self-contained race which would inevitably overwhelm in battle nations whose weaker elements had not been purged by the conditions of an equally severe environment.

"An area conforming to these requirements is offered by the forests and plains of eastern Germany, Poland and Russia. Here the race gradually evolved, and spread early into the Scandinavian peninsula, where it is now found in its greatest purity. History first shows them, very dimly, introducing the Sanskrit language to India, pouring through the passes of the Caucasus from the grasslands of southern Russia to invade Persia, and entering Greece and Italy from the north. About 1000 B. C. they crossed the Rhine into Gaul. They reached Britain about 800 B. C."

"The men of Nordic blood today form all the population of Scandinavian countries, as also a majority of the population of the British Isles, and are almost pure in type in Scotland and eastern and northern England. The Nordic realm includes all the northern third of France, with extensions into the fertile southwest; all the rich lowlands of Flanders; all Holland; the northern half of Germany, with extensions up the Rhine and down the Danube; and the north of Poland, and of Russia. Recent calculations show that there are about 90,000,000 of purely Nordic physical type in Europe, out of a total population of about 420,000,000.

NORDIC THE RULING ELEMENT

"Throughout southern Europe Nordic nobility of Teutonic type everywhere forms the old aristocratic and military classes, or what now remains of them. . . . In the Europe of today the amount of Nordic blood in each nation is a very fair measure of its strength in war and standing in civilization."

With a few trivial exceptions, then, all Europe is divided between these three distinct races—the Nordic, Alpine, and Mediterranean. Of course, it is not to be supposed that they do not overlap, or that a great amount of intermixture has not taken place. The settlement of North America was due to Nordics and, according to Mr. Grant, the early *conquistadores* of the New World represented the old Nordic element of Spain.

"Mental, spiritual and moral traits are closely associated with the physical distinctions among the different European races. . . . The Alpine race is always and everywhere a race of peasants, an agricultural and never a maritime race."

"The Nordics are, all over the world, a race of soldiers, sailors, adventurers and explorers, but above all, of rulers, organizers and aristocrats in sharp contrast to the essentially peasant character of the Alpines."

"The mental characteristics of the Mediterranean race are well known, and this race, while inferior in bodily stamina to both the Nordic and the Alpine, is probably the superior of both, certainly of the Alpines, in intellectual achievement. In the field of art its superiority to both the other European races is unquestioned."

As the Nordic has always been a race of fighting men, it is not surprising that it should have suffered severe losses, such as occurred during the Thirty Years' War in Germany, to name only one example. "All the states involved in the present world war have sent to the front their fighting Nordic element, and the loss of life now going on in Europe will fall much more heavily on the blond giant than on the little brunet."

"The wars of the last 2,000 years in Europe have been almost exclusively wars between the various nations of this race, or between rulers of Nordic blood.

"From a race point of view the present European conflict is essentially a civil war, and nearly all the officers and a large proportion of the men on both sides are members of this race. . . . It is hard to say on which side there is a preponderance of Nordic blood, as Flanders and northern France are more Teutonic than south Germany, and the backbone of the armies that England has put in the field, together with those of her colonies, are almost purely Nordic, while a large proportion of the Russian armies is of the same race."

In addition to losses in fighting, the Nordic race has suffered severe losses in recent centuries through emigration to countries where it could not thrive. Further, the author thinks it is less adapted to urban life than is the Mediterranean race, and is therefore succumbing under modern conditions to the competition of the latter. All over the world, the Great Race is passing.

THE NORDICS IN AMERICA

In America, Mr. Grant believes, the outlook for it is particularly gloomy, due to the disregard, during the last half century or more, of the elementary principles of biology.

"Race consciousness in the colonies and in the United States, down to and including the Mexican War, seems to have been very strongly developed among native Americans, and it still remains in full vigor today in the South, where the presence of a large negro population forces this question upon the daily attention of the whites.

"In New England, however, whether through the decline of Calvinism or the growth of altruism, there appeared early in the last century a wave of sentimentalism, which at that time took up the cause of the negro, and in so doing apparently destroyed, to a large extent, pride and consciousness of race in the north. The agitation over slavery was inimical to the Nordic race, because it thrust aside all national opposition to the intrusion of hordes of immigrants of inferior racial value, and preventing the fixing of a definite American type, such as was clearly appearing in the middle of the century.

"The Civil War was fought almost entirely by unalloyed native Americans."

"The prosperity that followed the war attracted hordes of newcomers who were welcomed by the native Americans to operate factories, build railroads, and fill up the waste spaces—'developing the country' it was called.

"These new immigrants were no longer exclusively of the Nordic race as were the earlier ones who came of their own impulse to improve their social conditions. The transportation

lines advertised America as a land flowing with milk and honey, and the European governments took the opportunity to unload upon careless, wealthy and hospitable America the sweepings of their jails and asylums." The result was that immigration of Nordics nearly ceased and the incoming stream was composed mainly of Alpines and Mediterraneans, and in many cases of the poorer representatives of these two races.

EUGENICS NEEDED

"As to what the future mixture will be it is evident that in large sections of the country the native American will entirely disappear. He will not intermarry with inferior races, and he cannot compete in the sweat shop and in the street trench with newcomers. Large cities from the days of Rome, Alexandria and Byzantium have always been gathering points of diverse races, but New York is becoming a *cloaca gentium* which will produce many amazing racial hybrids and some ethnic horrors that will be beyond the powers of future ethnologists to unravel." The only hope for the preservation of the Great Race, Mr. Grant thinks, is through general realization of the biological principles involved, and a thorough campaign of eugenics. He believes that democracy is not favorable to the preservation of superior strains.

Whether or not the reader wholly accepts Mr. Grant's estimate of the values of the respective races, or shares his pessimism about the future of the Great Race to which the founders of the North American colonies belonged, a study of this book is certain to result in a much clearer view of international problems, and a new conception of history which is likely to be more valuable than the conventional one which classifies people by nationality or language, instead of by race.

Colony Care for the Feebleminded

There are now in the United States several hundred thousand feebleminded persons who should be given custodial care (1) for their own protection, because they are unable to compete on even terms with people of normal intelligence, and (2) for Society's protection, in order that they may not reproduce their kind. The problem of finding ways in which they can be cared for without too great expense has been successfully met in a number of places by the establishment of colonies where they are economically housed, sexually segregated, made happy, and made to contribute largely to their own support. The colony plan seems to be the best yet devised for their care, and the Committee on Provision for the Feebleminded (702 Empire Building, Philadelphia) has issued an eighteen-page bulletin describing its operation in New Jersey, in such a way that other communities will know how to adopt it. Copies of this bulletin can be had for 5 cents each, singly, or at 3 cents each in quantities of fifty or more.

Annual Business Meeting of the A. G. A.

The annual business meeting of this association will be held, in conformity with the by-laws, in Washington on the second Thursday in January at 5 o'clock in the afternoon. Three members of the council are to be elected, those whose term of office expires being George M. Rommel, T. H. Kearney and W. C. Rucker. The regular annual meeting of the council is to be held on the third Tuesday in January, at which time officers will be elected.

HEREDITY VS. ENVIRONMENT

An Attempt to Show that the Jukes Might Have Been Reclaimed if Given a Good Environment—Evidence Alleged Has no Critical Value

A. H. Estabrook, *Indianapolis, Ind.*

THE Children's Aid Society of New York, in the "Emigration of Homeless Children to the Country," 1910, tells of one little foundling (page 7) who, upon investigation, was found to be descended from "Margaret, the mother of criminals," a member of the Juke family of criminals, paupers and defectives, described by Dugdale in 1874. In describing the Jukes and this case, the pamphlet says, "Had the little Margaret and her sisters been born fifty years later, their unfortunate parentage and environment would undoubtedly have brought them to the attention of some one of the organized associations to be found in New York City and throughout the State, for the rescue and care of just such neglected children. They would have been saved both from the criminal negligence of the parents, and the no less culpable indifference of the public, before their innocence had been lost and their youth perverted. Transferred to some good home among God-fearing people, amid proper environment and under judicious guidance, they would, in all probability, have developed into good true-hearted women, leaving behind them a line of descendants who in honesty and uprightness would have been a blessing, instead of a curse, to the community in which they lived and have been reckoned among the good and faithful, who are the backbone of the nation. That this is not a fancy picture, the concluding incident in connection with this family will show."

The article goes on to say, "Twenty years ago there came into the care of the Children's Aid Society a little foundling, who, upon investigation, proved to be a descendant of this same Margaret in the seventh generation. A home for the child was found in the country several miles from the nearest town, with a kind-hearted widow whose own children had grown up. A careful supervision was kept over him, and for ten years satisfactory reports were received as to his progress. Then the little fellow began to develop a spirit of unruliness, and owing to the advanced age of his foster mother it was thought advisable to place him under firmer guidance, and he was removed to a distant State and placed in a home far from town, where firm discipline was joined to great kindness. Here he remained until 1901. He had then reached his young manhood and achieved a thoroughly good reputation in the community, and he struck out for himself with a good moral foundation on which to build his subsequent career. Had he been allowed to grow up after the manner of his ancestors, who is prepared to foretell the result?"

As for the first part of the statement, no one knows whether Margaret or any of her sisters was normal mentally and so capable of benefitting by the improved environment which they should have had, or was feeble-minded and so would not have been able, under *any* environmental condition, to produce a line of descendants that would be good citizens.

SAM'S CASE PROVES NOTHING

Now the young boy, whom we shall call Sam for the sake of a name, was the illegitimate child of his mother, the *father being unknown*. It may be, then, that the boy inherited potential good traits from the unknown father. The recent investigation of the Jukes has shown that many of the intelligent, industrious men of the neighborhood had immoral relations with many of the Juke women, and this child may have

been the result of some chance meeting. The good environment furnished to Sam by the activities of the Children's Aid Society gave these traits a chance to develop. But, on the other hand, these good traits *might* have developed in the Juke environment. This has been the case with some of the other Jukes. In "The Jukes in 1915" (Carnegie Institution of Washington, 1916), page 80, case 7, is the story of a family group where the father, a great grandson of "Margaret, the mother of criminals," was mentally dull and slow at school, a farm laborer, a wanderer, and had two sisters who were harlots and one brother criminal, while another sister was chaste and reputable. This man married a woman from a family much higher mentally and socially than he, industrious and capable, and they had five children: a girl, reticent, but who holds herself well; a male, who, although slipshod, was regular in his work and did well by his family; a female, more active and forward than the first girl; a male, uneducated but a steady-going farm-hand, who is doing well; and a female, mentally and physically active. There is no evidence that this family was brought up in a new and superior locality. Their father wandered and he took his family about with him. The fine mother offered the best of environment for her children, even in the Juke territory, but she gave her children still more—an hereditary capacity for taking advantage of her training, a natural self-control sufficient to act in accordance with the *mores* she inculcated. Sam's case may have paralleled this case in that the Children's Aid Society furnished the environment which the fine mother did in the one mentioned; but the inheritance of good traits was necessary for the end result secured.

The case of Sam, then, does not show that good environment can counteract poor heredity, inasmuch as no one can tell what possibilities for good or bad traits Sam may have inherited because no one knows the traits brought to Sam by the father.

In saying the above I do not wish to discount any of the activities of the Children's Aid Society or any other well-meaning charitable organization for the bettering of social conditions, but the assumption that the environment can counteract heredity cannot be proved by any example of a production of good traits in a changed environment in any individual when the traits which that individual inherits are not known.

The writer of this article has but recently studied the Juke family and has a record of Sam. He was an illegitimate child and his paternity is not known. He was born in the poorhouse and was later placed in an orphan's home, and then given to the Children's Aid Society, when he was placed in the foster home as above mentioned. He disappeared in 1902, when he probably ran away. He was a descendant of Margaret Juke in the fifth generation.

Human "Free-Martins"

Animal breeders know that when twin calves of opposite sexes are born, the female of the pair is likely to be sterile and to have many male characteristics. Such females are called free-martins, and Lillie has recently shown (*Science*, 1916, p. 611) that in twin calves of opposite sex the foetal circulations are usually fused so that a constant interchange of blood takes place; the action of male hormones on the female is probably responsible for the ensuing sterility. The question naturally arises whether in human twins of opposite sex the female's reproductive system is in any way affected, and a number of correspondents of the *London Lancet* report that it is not. Sir James Simpson made an extensive study of this question and reported that "the human free-martin is fertile in the same proportion and to the same degree as other women." The contrary idea seems to be unfounded.

COEDUCATION AND MARRIAGE

Women Graduates of Western Colleges and Universities Show Widely Varying Marriage Rates, but in All Cases Studied are Higher than Those of Eastern Separate Colleges—Nature of the Problem Different in Each Institution

IT IS now well known to eugenists that only from 40 to 50% of the graduates of the great women's colleges of the United States ever marry. These women come, on the whole, from superior families, and the unfortunate results of their celibacy, from a eugenic viewpoint, are widely recognized.

Coeducation has often been suggested as likely to improve this condition, and several investigations of the marriage rate of women in coeducational institutions have been published, which seemed to substantiate this claim. Further data, however, have been needed.

It is now possible to give the marriage rate of the women graduates of the University of California, Illinois University, Ohio State University, Wisconsin University, Kansas State Agricultural College, and Oberlin College. In these great coeducational institutions, which are probably fairly representative of the universities and colleges of the West, it is found that from 50 to 67% of the women graduates marry.

A directory of graduates, published by the University of California alumni association a few months ago, lists 3,654 women. The first class graduated from the University in 1864, and in the succeeding twenty years just forty-nine women graduated, the first one of them securing her degree in 1874. After that the proportion of women in the institution steadily increased until at present they make up roughly two-fifths of the student body. One-third of the women graduates of the University of California, it is stated, are now teachers.

Taking the alumni directory, Arthur Price[1] tabulated every tenth name. This gave a random sample of the women graduates, but a rather small one for statistical purposes. He found the record as follows:

Period	*Per cent married*
1864–84	28.6
1885–94	50.0
1895–99	65.7
1900–04	60.1

The falling off in the last group, Mr. Price suggests, is perhaps due in part to the short time that has elapsed since graduation. The investigation of Wellesley data by Johnson and Stutzmann[2] showed that about one-fourth of the girls who marry at all, do so more than ten years after graduation.

Mr. Price further found that one-third of all the women who marry at all, marry University of California men. His explanation of the low marriage rate of the earlier classes is as follows:

"A generation ago, the girls who went to college were actuated by some explicit purpose, some particular zeal of learning. Now, it is a commonplace of experience for bright or studious girls, or girls who want a change of scene, to enter college and graduate. There are few California families of comfortable circumstances who have not at least one daughter a graduate or a student at the State University or Stanford."

It seems probable however, that the low percentage (28.6) is mainly due to

[1] See San Francisco *Examiner*, Sunday, October 1, 1916. Mr. Price has kindly given further details in a letter dated October 27.

[2] Journal of Heredity, Vol. vi, pp. 250–3. It was found that of the classes 1879–1888, 35% had married ten years after graduation, 48% twenty years after graduation. As the authors point out, this long delay in marrying is extremely dysgenic.

the small number of cases on which it is based.

The only class which Mr. Price studied in full was the class of 1906. The figures for this are as follows:

Total number of women graduates...	189
Married	90
Married to U. of C. men	30
Unmarried	94
No report	5

Alumni records of Oberlin College, Kansas Agricultural College, Wisconsin University, Illinois University, and Ohio State University[3] have been examined by W. L. Altman of the American Genetic Association, and the marriage status of the women graduates compiled. No information was found (except in one instance) on the birth rates of these women, nor was it possible from the published data to ascertain the marriage rate of the men.

The records of Oberlin College from 1850 to 1905, inclusive, show 1,682 women graduates, of whom 1,096 (65.2%) have married. The high marriage rate here, unlike that at the University of California, is in the earlier years. If the 688 graduates, 1890–1905, are counted, 380 (55.2%) of them are found to be married.

At Ohio State University the number of women graduates, 1885–1905, is 274, of whom 148 (54%) are reported married.

From Wisconsin, 1870–1905, 1,255 women have graduated, and 650 of them are reported married, a number that is 51.8% of the total.

The total number of women graduates from Illinois University, 1880–1905, is given as 550, of whom 297 (54%) are reported married. In the years 1880–1900 inclusive 134 of the total 222 graduates married and produced 253 children: 1.14 children per graduate or 1.88 per married graduate. Presumably these figures refer to surviving children, and they are likely to be incomplete statistically, while the families of the later graduates are subject to some increase through further births.

At Kansas Agricultural College, 386 women are listed as graduating in the classes 1885–1905, and of these 261 married, or 67.6% of the whole.

RECENT TENDENCIES

The question of most interest is the tendency to marriage in recent years. The five-year period, 1900–1904, represents the latest that can be taken profitably, and some who graduated in this period will yet marry. The percentages given are therefore slightly below the final ones. Various colleges for this period show the following marriage rates:

College	*Total No. grads.*	*No. married*	*Per cent married*
Wellesley[4]	...	...	44
Wisconsin	458	204	44.5
Illinois	288	135	46.9
Ohio State	114	65	57.0
Oberlin	234	138	58.9
California[5]	780(?)	480(?)	60.1%
Kansas Agric.	129	82	63.5

In all these figures, it must be remembered that only graduates are considered, and that a good many girls leave college at some time prior to graduation, for the purpose of getting married. At Wellesley Johnson and Stutzman found that the inclusion of these non-graduate girls would raise the marriage rate of the whole college by 5%. The conditions described by a young woman at the University of Wisconsin probably prevail in varying degrees at all other colleges where women are admitted.

"You asked me why half of the Wisconsin girls don't marry," she writes. "I think it's because they never could have married, educated or not educated. There are a lot of pretty girls here and there are an awfully large number of homely ones and, for that matter, homely men. A lot of the most attrac-

[3] *Bulletin of Oberlin College, N. S.*, No. 120, April 29, 1916; *Record of the Alumni of the K. S. A. C.*, 1914; *Alumni Directory of the University of Wisconsin*, 1912; *Alumni Record of the University of Illinois*, 1913; *Alumni and Students Register, O. S. U.*, 1912. The figures are believed to be corrected very nearly to the date of publication.

[4] Johnson and Stutzmann, p. 251. They give the per cent married from the classes 1901–1904 inclusive, but not the totals. Status of fall of 1912.

[5] Price's actual figures are 78 and 48. As these represent every tenth name on the list, the totals can be approximated by multiplying by 10.

tive girls don't get to be seniors. The freshman class always has the prettiest girls."

The percentage of graduates who marry from the women's separate colleges of the East appears to vary from 40 to 50, in most instances being nearer the smaller figure.[6] None of the coeducational institutions here considered shows as low a rate as this. Direct comparison is not legitimate, because each college represents a different social and geographical environment. The marriage rate, not only of college graduates but of all other women, may be lower in the East than it is in the West.

Furthermore, the percentage of graduates who marry is only one item of a number that must be considered by eugenics. In any discussion of the relative merits of the separate colleges and coeducation, it is important to know which group of women marries at the earlier age, which gets the better mates, which has the larger number of children and which brings the greater number of children to maturity. Data on these points are not now available.

There is no reason for surprise that the marriage rate of women from even the highest college should be low, when it is remembered that a good deal of selection has taken place before women go to college, as well as during the course of the college career. Many of those who take college degrees are girls to whom marriage is unattractive, or who are through some mental or physical characteristic not likely to find husbands, and who are, therefore, put by their parents into a "career." These girls would not have married in any case; therefore their chances were not impaired by a college education. In the case of many other girls, however, it is a serious question whether a college education is not mainly responsible for their failure to marry. Reasons have been set forth in previous issues of the JOURNAL OF HEREDITY for thinking that this is more true of the separate women's colleges than of the coeducational institutions.

Hindu Ideas on Heredity

THE SACRED BOOKS OF THE HINDUS, Vol. XVI. The Positive Background of Hindu Sociology, Book I. By Prof. Benoy Kumár Sarkár, with appendices by Dr. Brajendranáth Seal. Pp. 365. Price Rs. 6. Allahabad, the Pânini office, 1914.

Prof. Sarkár's volume, dealing principally with the ethnology, mineralogy, botany and zoology of the Sanskrit literature, offers many interesting glimpses of primitive science. His attempt to show that the early Hindus possessed considerable knowledge of plant-breeding is hardly successful, although it is certain that they were familiar with such processes as grafting. In an appendix on Heredity, Dr. Seal says that the early Sanskrit scientists held a view of evolution corresponding to the *emboîtement* theory, that Charaka had put forth an hypothesis almost identical with Darwin's hypothesis of pangenesis, and that the isolation of the germ-plasm was well understood. The idea of continuity of germ-plasm was never reached, although it logically followed from the views held. It was clearly recognized that a character, to be inherited, must originate in the germ-plasm, not in the body, and the non-inheritance of acquired characters was explained by this very good hypothesis. Speculative views on evolution appear to have been shrewd, ape-like forms being designated as man's ancestors, while it was also pointed out that man's ancestors must at one time have been aquatic. The author believes that Hindu philosophers must be recognized as having long antedated the Greeks in the foundation of biological science.

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[6] For the details see Sprague, Robert J., Education and Race Suicide. JOURNAL OF HEREDITY, Vol. vi, pp. 158–162. The methods of compilation vary with each college. The marriage rate at Mount Holyoke appears to be only 41.9, at Bryn Mawr 43.9, at Vassar 49%.

INFLUENCE OF HEREDITY IN STAMMERING

Frank A. Bryant, M.D.
New York, N. Y.

STAMMERING or stuttering (I use the terms synonomously, for most English speaking authorities agree that stuttering is a form of stammering) is one of those traits which is difficult to classify as either wholly mental or wholly physical. At first sight it would appear to be a physical defect, but closer study shows that this view is not tenable. It is not an organic trouble, but a functional one, as is proved by its intermittent manifestations, which point also to its purely nervous or mental origin. It is ordinarily due to a morbid irregularity or interruption of the normal functions of the mind in its relation to speech.

This is not an argument against its transmissibility, however, for the child inherits his brain from his parents just as much as he does any other part of the body. The inheritance of various mental disorders is as firmly established as is any fact in biology. There is *a priori*, then, no reason to suppose that a tendency to stammer might not be inherited; to determine whether or not it actually is inherited, we must appeal to the evidence.

STUDY OF 20,000 CASES

In a practice of over thirty-five years, I have come in contact with more than 20,000 persons afflicted with stammering in its various forms. According to my observations and statistics, at least half of these 20,000 stammerers had relatives who at one period or another in their lives suffered from one form or another of nervous speech disorder.

In the early stages of the stammering of very young children, it begins spontaneously, seemingly without any external cause, upon the very first attempts to speak. While some cases do not show the affection until after the third or fourth year, I have never known an instance where it began with the early attempts at speech unless some blood relative had previously shown disordered utterance.

This early manifestation of the trouble precludes absolutely the assumption that it is a habit or the result of faulty education, example or environment, because the child on account of its extreme youth had never been brought under such influences.

My statistics show that the number of stammerers with relatives who have stammered is greater than the number of stammerers from all other causes put together. This furnishes a strong presumption of inheritance, which is converted into absolute proof by a study of the nature of some of these cases of relationship. It is a fact that grandchildren frequently stammer who have never seen the grandfather or grandmother who stammered. The speech of the nephews and nieces of an affected person is likewise impaired; and cousins who have never seen each other frequently stammer. Such crucial instances offer the best evidence possible of real inheritance.

Many cases of what might be called atavism have come under my observation. I mean cases of stammering which seem to have skipped one or more generations. The following description of what occurred in one family of my practice will illustrate the point.

> A man who lived to be 80 years of age was a stammerer from childhood. It could not be ascertained whether any of his relatives had ever been afflicted in this way. He had two sons, Robert and Henry. Robert, the elder son, showed stammering in his first attempts to talk. He grew to manhood a stammerer, married and had two or three children, neither of whom was afflicted with speech trouble.
>
> One of these children, William by name, also had two children, a boy and a girl, both of whom stammered quite severely from no apparent cause from the time when they first began to speak. This was in the fourth generation from the

original stammerer. The affection had skipped the grandson, William, to appear again in the great-grandchildren. Fortunately, I, with the aid of good sensible parents, was able to take them in hand within a few weeks after it first appeared in each case, and it was soon cured. These children are now 12 to 15 years of age, and they are now and have been ever since their early treatment, absolutely free from any trace of stammering. In fact, the boy is quite a young orator.

Henry, the younger son of the original stammerer, although constantly associated with his stammering father and stammering brother Robert, never showed any signs of the disorder, but curiously enough, his son James became a bad stammerer. This boy James, whose father, Henry, was skipped, was a grandson of the original stammerer. He also was cured, but not until some years after it made its first appearance.

The individuals referred to were all native born intelligent Americans, enjoyed good health, had no stigmata, no bad habits, were not "nervous" people, and occupied stations in business and professional life rather above the average. The facts as related are authentic, for I saw all the persons mentioned; and I believe it to be a true example of the effect of heredity in causing stammering.

SUMMARY

Stammering, in most if not all cases, being due to an unusual excitability and instability of those cells of the cortex which preside over the function of speech, it follows from the general principles of heredity that when such a condition exists in a parent it is likely to be reproduced in the child.

Statistics confirm this expectation, showing a family history of stammering in a majority of cases.

The affected relative is often one whom the child has never seen. This, with the fact that stammering often appears at the first attempts to speak, precludes the idea that the defect is due solely to imitation, and proves that we are dealing with a true germinal trait. When a parent stammers, part of the children may stammer and the rest speak normally, a further proof that association and imitation will not necessarily cause stammering unless there is a inherited predisposition.

Cases of inherited stammering, if treated early, are usually curable.

Japanese Tests of Tree Seeds

In 1902, the International Association of Forest Experiment Stations arranged a coöperative research to extend over ten years. The Japanese section of this was concerned with three important forest trees: *Cryptomeria japonica*, *Pinus densiflora*, and *Pinus thunbergi*. Among the interesting conclusions published by H. Shirasawa and Koyama are the following:

1. Seeds obtained from a young seed-tree (20 to 30 years old) are large and seedlings grown from such seeds show a better growth.

2. Seedlings from the seeds produced in localities warmer than that of the nursery, will grow better than those obtained from colder districts, so that it is always advisable to bring seeds from warmer places; if there is fear of frost, care should be taken to protect well against it, since the seeds from warmer localities continue their vegetation later in the fall, so that new buds coming late may suffer from an early frost and perish in winter.

3. Forest trees, grown from seedlings originating in warmer districts than the nursery, bear many flowers and fruits in their early years; trees grown from the seeds of a climate colder than that of the nursery bear few flowers and fruits and are very slow in growth.

As to the influence of the age of the seed-tree, old trees give rise to a smaller number of fertile seeds capable of producing saplings, but which are of slower growth. This is particularly true in the case of *Cryptomeria japonica;* but in the case of *Pinus densiflora* and *P. thunbergi*, the difference is hardly recognizable.

For the reasons above stated, the best tree seeds should be taken from a young seed-tree grown in a locality similar in climate to the place where the seeds are to be sown.—Abstract from *Int. Inst. of Agric.*

The Journal of Heredity

(Formerly the American Breeders' Magazine)

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AN EXCESSIVE SUPPLY OF DIGITS

Due to the splitting of his thumbs and great toes this boy has more than his share of fingers and toes. Some of the other members of his family are likewise affected. Polydactyly, as this abnormality is called, is hereditary in some degree. (Frontispiece.)

See "A Polydactylous Family," p. 96.

CORN AND EDUCATION

Potentialities of the Individual Are Foreordained at Birth—Education Can Only Reveal the Innate Traits Already Present—Equal Opportunity for All Is Not Desirable in Education

Albert F. Blakeslee

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TO THE biologist the proper study of mankind is plants and the lower animals. That man is an animal is indeed taught in childhood. We have learned the phrase, but actually we think rather of man as distinct from animals. We have felt a great gulf separating us from other living beings. Only in relatively recent years have we come to realize that the greatness of this gulf has been exaggerated. Man as a living organism is subject to the general laws of life, but his very complexity of mental development, as well as other reasons, makes him a poor subject for discovering these laws in himself. Biologists accordingly make comparatively little experimental use of man himself in investigating fundamental principles of life.

With corn one may illustrate certain conceptions which will doubtless appear trite to trained biologists, but which experience shows are not appreciated by most intelligent men, even though they may be specialists in education. Such lessons drawn from corn have been found of value in the writer's classes in the discussion of human inheritance.

The words *education* and *educator* have acquired such popular respect that they are often used as mere advertising names to attract buyers. Thus we have "educator" shoes and "educator" crackers. Education is indeed a word to conjure with. It is truly a master key which unlocks the known treasures of the past and opens the door to unknown treasures of the future. It is a prime factor in the progress of civilization and has been offered as a panacea for social ills. Educate the masses, it is thought, and all will be well. Education is esteemed as a stimulus towards the mental, moral and physical betterment of the human race. It is conceived of as a cumulative and creative force acting from generation to generation towards the upbuilding of a better race of individual men.

Education can accomplish much, but can it accomplish all that has been claimed? What are its possibilities and what its limitations in affecting the stream of human evolution?

TWO TYPES OF EVOLUTION

Before seeking an answer to these questions, it will be desirable to distinguish two types of evolution, social and biologic. *Social evolution* deals with changes in man's surroundings. It involves not merely the increase in accumulated knowledge and material things that have been handed down from one age to another, but as well the changes in thought, customs and standards that have thus been acquired. *Biologic evolution*, on the other hand, deals with changes in the inherent nature of man himself. It takes account only of such alterations in physical and mental make-up as can be transmitted to later generations.

In social evolution it goes without saying that education has been a constant factor. Knowledge has brought about a closer adaptation to the world in which we live. Our standards of life and thought in consequence have improved. Civilization has advanced and man is situated in better surroundings than ever before. But has education made man intrinsically a better

CORN THAT IS WELL-RED AND CORN THAT NEVER CAN BE

When inclosed in their husks, the two ears of corn shown above have kernels of the same color. But those of the upper ear possess the property of turning red when exposed to light, while those of the lower one do not. The upper variety has therefore received the name "Smut Nose," since light is usually admitted at the end of the cob and brings out the red color. The difference in the two varieties of corn is merely one of capacity to respond to a given stimulus; if the stimulus (light) is never applied, the two ears will remain just alike in color. Photograph by John Howard Paine. Lower ear natural size, upper ear slightly reduced in reproduction. (Fig. 1.)

species, mentally and physically, now than centuries ago? In other words, has education exerted a beneficent influence upon biologic evolution? The answer is not so obvious as in the case of social evolution.

Let us turn from man for a moment to the simpler condition in corn. In Fig. 1 are shown two varieties of flint corn differing somewhat in size, but of essentially the same color of kernels when enclosed in their husks. The upper ear, however, has inherited the power of developing red pigment when exposed to the light. The kernels at the tip where the husks admit light are regularly colored, hence the name of "Smut Nose" given to this variety. To make the evidence of this response more striking, the writer enclosed an ear in dark paper with the letters L-I-G-H-T cut out in stencil. In the photograph (Fig. 2) the effect is evident where the light has been admitted but, since the "T" did not print well in the region of the tip where the kernels failed to develop, the evidence seems to spell out a "ligh."

We may call the red kernels "educated corn." They are well-red in response to the external influence of the light of the sun in the same way in which a man may become well-read in response to the external influence of the light of education. While enlightenment or darkness may influence the appearance of the individual either of corn or of men, such environmental factors can have no effect on the capacity which alone is inherited. It is difficult for many to realize that a given characteristic is not inherited as such, but only as the power of developing that characteristic when the organism is subjected to the proper environment. What corn or men *appear to be* must be distinguished from what they actually *are* so far as their potentialities are concerned. If kernels were taken from the base of the ear of the "Smut Nose" corn, they would be white, and thus would resemble in color the Rhode Island flint corn, below in Fig. 1; while if the kernels were taken from the tip, they would be red and thus would resemble the red variety in Fig. 3, which is always red whatever the illumination. Yet all "Smut Nose" kernels, red or white, produce the same kind of offspring. They are actually similar potentially, though appearing unlike. No amount of illumination, though carried on for countless generations, can make the Rhode Island flint a well-red race of corn. It is not in the "blood." It lacks the capacity to respond sufficiently to the influence of light in the same way in which many types of humans lack the capacity to respond to the illuminating influence of education. On the other hand no amount of darkness, though continued for ages, can suppress in the kernels of the Smut Nose variety the power of becoming well-red when given the opportunity of exposure to light. It keeps and transmits its capacity unchanged by the influence of light or darkness.

The human race kept in darkness or exposed to the light of education is as little directly affected in its innate ability as these races of corn are by light. The higher education or the lack of education of women, for example, which has been so much discussed, can have no direct biologic influence upon the nature of their children.

EDUCATION ONLY A STIMULUS

Education is merely a stimulus like light that does not create nor change the real nature of an individual but only reveals the powers within. It follows, therefore, that no amount of exercise of mental or physical powers of parents—in other words, of education—can directly affect their children. A man blinded at birth would have no opportunity to practice the painter's art, however great the artistic gifts with which he entered life. Yet his children would inherit no less artistic power than if he had retained full sight and gained renown by his artistic production. This is not to say that in both cases the chances would be equal of the children developing into recognized artists. On the contrary any artistic education of the father would be handed down by example to the children and afford them a better opportunity of recognizing and develop-

LIGHT IS LIKE EDUCATION IN EFFECT

Light acts on Smut Nose corn as education does on men—it brings out latent capacities. The ear of corn above photographed was enclosed in dark paper, with the letters L-I-G-H-T cut out in stencil from it, to make more evident the effect of light in developing red coloring. The kernels at the T failed to develop, but the first four letters are clearly visible. If the capacity to turn red has not been inherited, light produces no effect; similarly education produces no effect on man unless there are inherited capacities for it to work on. Photograph, reduced in size, by A. F. Blakeslee. (Fig. 2.)

ing any artistic talents they might possess. Mere practice in art, however, could never be inherited biologically, though it might be socially. Education is thus to be distinguished from the ability to respond to education which alone is inherited.

Fig. 3 represents a "King Phillip" variety of corn that is unchanged by light or darkness. The kernels are covered by an opaque red skin and look alike. Where the skin has been scraped away, however, it can be seen that they show different colors. Some are dark yellow; others are white. Scraping away the red skin does not prevent the red character from appearing in the skin of kernels in the next generation. It is merely a surgical operation that lays bare the parts within and has no hereditary significance. Education may thus act as a knife that scrapes away some barrier, inherent or acquired, and reveals the unsuspected character within. One born blind and deaf is as mute to express the mental life within as would be another born mentally deficient though with sight and hearing intact. Yet education has overcome the physical impediments in cases like the first and discovered treasures of thought which else would have lain concealed. In cases like the second, education could avail little. It could not discover what was not present.

We start life like a photographic plate which has been exposed: there is a potential image ready for development. Chemical solutions in the hands of the photographer furnish an environment which reveals the lines already impressed upon the negative. Differences in this environment brought about by changes in the chemicals or in the time employed in the development may alter the appearance of the finished picture. The light parts may be made brighter, or dulled. The image may be suppressed in places and intensified in others. The whole color tone may be changed by the proper choice of solutions. Soft and harsh, warm and cold, bright and dull, and other terms descriptive of human character have been borrowed by the expert photographer to characterize the effects he can produce in a picture by changes in his methods of development. And yet the development can bring nothing new into the picture not already foreordained at the moment its outlines were impressed upon the sensitized plate when exposed in the camera.

REALITY OF PREDESTINATION

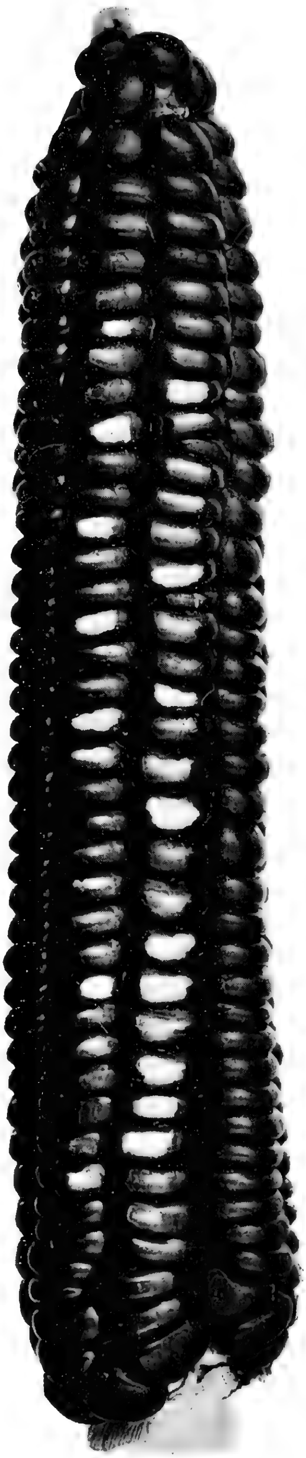
A human life is an intricate picture, a varied complex of lights and shadows, the possible outlines foreordained at birth. Education is a developer which may intensify parts of the image and inhibit others but can create nothing.

We have seen that education is of prime importance in social evolution but we must admit that it is of no direct value in the biologic evolution of the human race. Education, like other

"acquired characters," in corn or in men, cannot be biologically transmitted to succeeding generations.

But has education, it will be asked, no indirect influence in producing a better or a worse race of individual men? The question is one of relative rates of reproduction. Does education increase or decrease the number of individuals with desirable or undesirable traits? Only as it does increase or decrease such types of individuals can it be said to have any influence, good or bad, upon the biologic evolution of the human race.

In the cultivation of corn may be seen at work forces similar to those acting in the education of men. Farmers formerly mixed a small quantity of a red variety in their sowings of corn to heighten interest at the old-fashioned husking bees. Such a sowing would produce what is technically known to breeders as a mixed population. The plants with red ears would be rare—would form only a small proportion of the total population in the field. This proportion could be increased or decreased in succeeding generations by conscious selection by the farmer of a larger or smaller number of red ears for planting. Such selection might be dictated to him by economic considerations. On the other hand, if the corn were shelled and a definite quantity of this mixed seed were sown each year, the proportion of plants with red ears in the field in succeeding generations would depend upon the relative rates of reproduction of the two varieties of corn. If the red variety were more prolific, the proportion would increase and the red corn in succeeding generations would eventually supplant the other variety; while if its rate of reproduction were less than that of the other, it would in time disappear from the farmer's field. Which of the two varieties would show the greater rate of reproduction might depend upon environmental factors such as climate and character of soil where



HEREDITY UNCHANGEABLE

This red ear is unchanged by light or darkness, and the red exterior does not tell whether the kernel underneath is yellow or white. Photo, slightly reduced, by J. H. Paine. (Fig. 3.)

they were grown. Thus an increase or decrease of varieties of corn in a mixed population might be consciously or unconsciously brought about by their relative rates of reproduction. The same may be said of varieties of human beings.

It is conceivable that a nation suddenly become educated in science above its neighbors would, thereby, be enabled to succeed in its wars of aggression and to establish a national dominance over less educated peoples. Unless, however, the subjugated races were reduced in population or in their powers of reproduction by such conquest, the dominant nation would contribute no increased share to the composition of the human race as a whole. History, however, does not warrant us in assuming that conquest increases the relative rate of reproduction of the conquerors. In civilized countries the effect may be the opposite. Even if the conquerors were favored in the reproductive rate, what would be increased in transmission would be merely the relative average ability to react to education possessed by the dominant race. This example of a possible biologic advantage of education at the present time seems extremely doubtful.

TWO DIRECT EFFECTS

There are two ways, however, in which it is generally agreed that education directly affects the rate of reproduction. On the one hand, knowledge of the laws of health decreases the general mortality, especially in infancy, while on the other hand, education, if prolonged, delays marriage and decreases the number of offspring. Unfortunately these two influences do not balance. It is a striking fact revealed by eugenic investigation, that the average number of children born and brought to maturity in educated families is far less than in uneducated families. Statistics show that college graduates are not having children enough to keep up their numbers—and this seems truer for graduates of women's colleges than for those from men's colleges. In other words, educated men and women are not reproducing themselves.

Little in the way of organized effort is being accomplished to equalize the relative rates of reproduction, either by increasing the birth rate among the educated or by decreasing the birth rate among the uneducated classes. On the contrary, those who recently have attempted to disseminate information which would tend to lower the birth rate of the uneducated have been arrested and threatened with imprisonment. The movement for birth control is biologically of advantage in so far as it tends to equalize the relative birth rates of the better and less desirable varieties of men.

It is true that education is only one of the associated factors involved in the decreased rate of reproduction of the so-called educated classes. The educated take more thought for the morrow. After estimating the relative cost of a child or of an automobile, they sometimes choose the latter. Automobiles undoubtedly increase the tendency toward race suicide. The same may be said, however, of any other luxury or economic necessity that foresighted parents allow to interfere with the normal increase in the size of their families.

If the upper classes represent in native ability a fair average sample of the whole population, their decreased rate of reproduction may have no great significance since the losses in their ranks could be made good by the education of those in the classes below them. The educated, however, are not a mere average sample. They constitute a select group containing not only those most educated but in large proportion those most capable of education. The greater the opportunities offered to all, the more closely will the grade of education attained represent the innate ability. At the present time, therefore, the relative low rate of reproduction of the educated is truly alarming. The contention seems plausible that the downfall of Rome and of other ancient civilizations is to be attributed largely to this very influence of education in decreasing the relative birth rate of their better classes. It is not the purpose of the present article, however, to follow further the effects of education

on the biologic evolution. It is sufficient if we have shown that, although education has been of service in social evolution, its influence in biologic evolution at the present time is of little service if not of distinct harm to the human race.

THE LESSON FOR EDUCATORS

Have the findings of biology no lessons for the educator? Education in the past has tended strongly toward uniformity. Biology, however, teaches that the human subjects are far from uniform. Disproportionate time and effort have been spent in an attempt to raise the less capable to the average level of the class, while the most capable receive no extra attention and are held back by the ability of those below them. Special teachers are trained and courses organized for backward pupils. In reform schools and institutions for mental defectives, the equipment and facilities for instruction are often superior to those in schools for normals. Biology teaches the tremendous value of exceptional capacity whether in plants, domestic animals or in humans. The superiority of our present agricultural plants and animals over the average wild forms from which they have come is due to the continued selection of such rare superior variations as nature has offered. Breeders have merely recognized the best and given them the best opportunities. There is no good evidence that cultivation or education acting alone has caused the production of these rare variations of merit. They have merely been offered an increased chance of recognition and when once recognized they have been given opportunities for proper development.

We do not advocate the neglect of the less capable, but we do advocate a change in our evaluation of different grades of abilities. It is wise to expend the greatest effort on the recognition and advancement of the most capable. Thus can both the social and the biologic evolution of the human race best be favored.

We hold that in corn or in men the potentialities of the individual are foreordained at birth; that these potentialities are alone inherited; that education can merely reveal the innate characteristics already present; that, no men being created equal, we should not seek in education for equal opportunity for all, but should seek earnestly after those with the best gifts, should hold fast, protect and increase that which is good.

The Original Geneticist

Credit for being the first professional geneticist apparently must go to Samuel T. Fowler (born 1821), brother of the better-known O. S. Fowler, phrenologist. He described himself as Professor of Genetics and published a 192-page book entitled "Genetics" at Philadelphia in 1882. He defines the science as "pertaining to the origin, production, source and genesis of things," and the subtitle of the book calls it "a new system of learning, based on the analogies comprised in a complete abstract of the requirements of genitive law, as they apply to the origin and production, or to the source and genesis, of the star, plant, zo-onic and societary worlds." Fowler apparently would have leaned toward biometry, for he states that the "science" formulated itself in his mind wholly in algebraic symbols, and that his greatest labor was to find words in which to express these. His effort in this direction was hardly successful, for he covers pages with discussion of such things as "the composite centerstandive principle of procedurity," and a large part of the book is utterly senseless, a fact which has considerably enhanced its prestige in the eyes of some, so that it is said the work (long out of print) sometimes sells for as high as $50. It is a weird composite of astrology, phrenology and home-made symbolism. Just as geneticists today end their books with a chapter on eugenics, so Fowler concluded his by setting forth a scheme for the fundamental reconstruction of society, in which he showed himself to be an advanced feminist.

CONSTRUCTIVE ASPECT OF BIRTH CONTROL

Some Classes Need More of It, Others Need Less—Birth Control Movement Only a Part of the General Problem of Population—A Program for Eugenics[1]

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IN THIS paper I shall not expect to introduce new data on the birth control question. It has already been proved, to my satisfaction at least, that birth control under certain conditions is desirable for the highest interests of the family and society. I also know that birth control is carried to an excessive degree among the middle classes of our native population in the industrial and intensely civilized regions of this country. I wish to show in this discussion the relation which birth control bears to the greater problem of population and race vitality in the United States.

Excessive birth rate beyond the ability of the parents to support and the resources of the nation to provide opportunities is one of the greatest evils that can befall a people.

In China, under the fallacies of ancestor worship, population treads upon the heels of subsistence, with the result that famine, pestilence and flood must consume the surplus.

In India, early marriage and excessive birth rate, stimulated by religious and philosophical folly, crush the hopes and possibilities of the race, prevent the education of the young, the creation of capital and the development of the human resources, leaving a tangled, squirming, starving mass of hopeless humanity, stunting and crippling one of the brainiest types of the human race.

The barbaric birth rate of ambitious Germany, hemmed in as she is by the other nations, made the great war inevitable and will, if it keeps up, make wars forever in the future. Some believe that this will work eugenically for the survival and predominance of the strongest and best race, but this is still a mooted question.

The survival of the merely "strong" may result in the survival of the strong hog. Pressure of population on subsistence and area develops brutality, selfishness and disregard for human life; it crushes leisure, generosity, and art and makes impossible some of the finer virtues of a race.

BIRTH CONTROL VS. BIRTH RELEASE

For one great section of the population we need birth control and for the other birth release. Massachusetts is the only State that has for many decades taken birth statistics on a basis of nativity and these show that the birth rate of her foreign-born population is about three times the birth rate of her native, mostly Anglo-Saxon, people; the birth rate being fourteen per thousand and the death rate eighteen per thousand in the same native group. There are many reasons to believe that practically the same situation holds in other States among the people of the same class. Merely to sustain the population and not to increase it every married woman

[1] Read in New York City at the thirteenth annual meeting of the American Genetic Association, December 27, 1916.

capable of bearing children must, as an average, bring to maturity at least three children. Of the graduates of our women's colleges only one-half ever marry and the average number of children per graduate is less than one.

Birth control among the poor is needed for themselves but birth release among the upper classes is a greater necessity, both for their own welfare and the salvation of the nation. Excessive birth control by those well able to have families sufficient for the nation's growth weakens the nation at every point, necessitates the importation of indigestible foreign elements, good people in themselves but poorly adapted to American life, weakens patriotism and brings about a mixture of races which makes confusion of morals, dearth of art and literature and conflicts between classes.

Birth control among the poor is a problem, but race suicide among the middle classes is a racial menace which threatens by its influence to defeat the highest ideals of the nation.

There ought to be reasonable birth control by all classes based upon high ideals for the nation and family, responsibility for offspring, and refinement of soul and character of the parents. The free indulgence of sexual passions, coupled with the prevention of conception by mechanical contrivances, is possibly better than no control whatever, but it deals with the matter on a low basis of animal appetite and gross physical force. It is not control of the highest and best kind, it throws all the burden and dangers upon the wife. But there is a control possible to people of high standards which is the result of forethought, character and mutual sincerity and which gives none of the dangers and secures the noblest end of spititual union by means of physical function.

BIRTH CONTROL—RATIONAL—NECESSARY

Gradually man has been reducing his life from a world of chance to one of human control and order. Finally his children will be the result of foresight, plans, ideals and self-control. Self-control is the second fundamental factor of personality which makes man higher than the animals and the Son of God. Man has learned that corn and potatoes must be given proper spacing lest Mother Earth be crowded and they do not grow well, but he has often forgotten to place sufficient spacing between his human children that they might develop to the highest. Crowding children beyond the strength of the mother and earning power of the father breaks down the mother physically, crushes the spirit of the father, stunts the children in all ways, prevents the normal development and happiness of everybody, and creates material for submerged classes and social problems. Human selection, brains and foresight must take the place of carelessness and accident. For her own sake and that of both children, no mother who does her own housework should become pregnant until the previous child has gotten on its feet and can handle itself to a large degree. Birth control of the right kind is merely the dominance of mind over matter, of intellect over chance, of moral obligation over passion; it is a philosophy of conservation of human resources and the eugenic direction of human love.

ARGUMENTS AGAINST BIRTH CONTROL

The two leading arguments brought against birth control are that (*a*) it defeats the intention of nature and therefore of God and (*b*) it will encourage immoral practices.

The same party who makes the "defeat of nature" argument goes to his home and eats bread made of wheat which nature intended for some other purpose, potatoes that were created for the production of other tubers, eggs whose sole end in nature is chickens, and chickens whose natural goal is eggs, milk and cream that should have been given to the calves whose skin he wears on his feet. His clothes are made of cotton created to distribute the seed which has been crushed for oil with which he paints his house or lubricates his automobile, and this man's whole day is a progressive defeat of nature's purposes, but all

for the welfare and development of the higher creature, man, who was commanded to subdue and populate the earth. The whole course of the progress of man has been the everlasting control and limitation of nature, and her subordination to his higher life. Surplus seed is the most wonderful phenomenon of nature on which the whole human race depends for existence and on which it builds its structure of the higher life. So the human sexual relations under control may temporarily limit nature for the sake of elevating man by securing stronger spiritual union between the sexes, by securing better children at proper times and intervals, and thus causing the emergence of a stronger race. Birth control does not necessarily mean smaller families, but it does mean better families, brought forth and developed according to the right mingling of reason and love. America needs at present a higher quality of population more than she needs a greater quantity; she needs more normal families of the successful classes, not larger families of the unsuccessful. The number of children reared into decent citizenship, not the number born in poverty, is what makes the American family happy and the nation strong.

Will it encourage immorality?

It may in some isolated cases in the same way that any useful invention or knowledge may be put to evil purposes by those who are so inclined, but even with that assumption its possible benefits outweigh all such possible evils. Birth control is already practiced, perhaps too much, by the middle and richer classes of America, but the immorality of those classes apparently does not exceed that of the poorer people where it is less common. Birth control will ultimately have a selective effect on the population in that the selfish and unpatriotic will have a better opportunity to eliminate themselves and leave the world to more normal and wholesome stocks. A program of mechanical contrivances handed out to the ignorant people without any vitalizing constructive idealism for the family and the nation may encourage indulgence in physical passion and degrade family life in many cases. Birth control must not be made the scapegoat for the sins of selfishness and passion. We must have a constructive family ideal and race enthusiasm which will provide the dynamic for both proper increase in the number of population and birth control in the interest of the quality of life.

THE PROBLEM OF POPULATION

Birth control must not stand by itself and be preached and judged as an unrelated thing: it is only one important factor in the great program of the nation's problem of population and race vitality. How is the population of America to increase in the future? The middle classes of the industrial regions are not maintaining their numbers by natural process. The birth control advocates would have the poor people restrict their families to the limits of their income and would show them how to do it. Where then shall we get the next 100,000,000 which we are sure to have and which the nation needs and can easily provide for? Evidently from the poverty-stricken classes of the Russians, Italians, Syrians, Portuguese, Mexicans, Negroes, etc., because the western Europeans may have few emigrants to send us for years to come.

If the insufficient birth rate of the upper classes were to continue and we were obliged to get our increase in numbers either from the overflowing poverty-stricken families of foreign countries or from the poor classes of our own population, I should say, from the point of view of national welfare, let the increase come from our own people reared under our own flag, language and customs, even though in poverty. The adoption of birth control by poor families to the extent that it is practiced by the economically higher classes will condemn this continent forever to be, not only the mixing bowl of the world, but the scrap heap of the races. These people may be themselves as good as any of us, but forever mixed together from the ends of the world, they cannot make a nation.

Nations composed of mixed races are weak in most of the things that make for national strength and progress. Lacking the unity of traditions, idealism and national spirit they are liable to have excessive individualism and turn to materialistic goals.

If in America we are to develop a national unity, a great American art and literature, a full realization of American genius for all classes and races already with us, and a respectable position of influence in the world's progress and affairs, we must have a birth rate among all classes sufficient to maintain, increase, and unify the people of the United States into one great social and national body.

IDEALIZATION OF THE FAMILY

This nation must set up a goal of the normal American family and racial independence. It must idealize the family instead of the individual and work for its success by all forms of legal, social and economic readjustments that are necessary for the accomplishment of these ends.

If we are ever to ripen and perfect our civilization we must not depend upon the pauperized villages of Europe, the deserts of Asia and the jungles of Africa for our population. We must determine to rear our own population from our own best stock, and so organize and utilize the resources of the country that all classes may bring their families up to the high standards that are possible to us.

America was founded on great principles which the world needs to have preserved, but without a sufficient birth rate the old population will pass away and her mission to the world will not be fulfilled.

Let us have birth control, but let it be preached as a part of the nation's larger program for racial independence and high standards of life.

GENERAL REFORMS

Nearly all great social problems spring from some fundamental weakness or nonadjustment at the base of the social system. No one of these evils can be cured entirely without purifying the soil from which they spring, and thus affecting them all. Crime, prostitution, drunkenness, and the evils of too many and too frequent births among the poor are largely the results of ignorance and poverty. Any program which raises the intellectual and social standards of the classes affected will cure them all to a large degree.

We have three great problems on which we must work out solutions. (*a*) The unequal distribution of property, which I will not attempt to discuss here; (*b*) our system of government, which must be purified and redirected toward the interests of all the people; (*c*) our educational system, which has been inadequate to giving all of our young people the proper start toward earning power which they ought to have.

Raise the standards of the poor through education and economic betterment and birth control problems will practically disappear. But then we must face the larger question of sufficient race enthusiasm to maintain the normal family in all classes at high standards. Here is where I wish to offer a few suggestions as a program for encouraging and sustaining the family.

This program calls for three lines of action:

I. Conservation of human resources already available.
  - (*a*) Prevention of sickness by health associations and insurance.
  - (*b*) A broad program of sanitary engineering and prevention by control of disease.
  - (*c*) Abolition of child labor.
  - (*d*) Gradual extermination of urban and rural slums.
  - (*e*) Birth control.

II. Use of Government and other organized agencies for encouraging and protecting the family and enabling people of high standards to maintain such.
  - (*a*) Control of building sites and districting of cities in the the interest of homes and family welfare.
  - (*b*) Ownership or control of local public service utilities, water, gas, lights, etc., so that the

family will not be burdened with the highest possible rates while other consumers get lower ones; and so that these utilities may be managed generally to encourage home building.

(*c*) Capitalize building programs and control types of construction so that good homes are provided and the individual may not be compelled to settle for life because he needs a good house.

(*d*) Plan cities, towns, and country side for the health and happiness of the family in the matter of streets, parks, playgrounds, pools, etc.

(*e*) Control food distribution where it is necessary, and provide market systems.

(*f*) Government ownership of railroads, which would enable us to have:

1. Family tickets.
2. Week-end family excursion rates.
3. Workmen's trains.
4. Cheaper restaurant facilities.
5. Higher age limit for free passage of children with parents.

(*g*) Tax reform.

1. Tax the minimum home at lower rates than other property.
2. Reduce income taxes as family increases to normal size.
3. Reduce taxes on occasion of extraordinary necessary expenses of children.

(*h*) More free vocational and useful educational for boys and domestic education for girls, including dressmaking, cooking, nursing, child rearing, etc.

(*i*) Free medical attendance at child birth and free medical advice by district nurses.

(*j*) Encouragement of mothers to teach school.

(*k*) Social insurance with its aim to unite and encourage the family rather than the individual.

III. Eugenics, negative and constructive.

(*a*) Birth control to prevent the preponderance of births among the poorer classes and to raise the average quality of human life by proper protection of the mother and proper intervals between children.

b) The sterilization of some proved degenerates and the segregation of others.

(*c*) The teaching of the principles of breeding and eugenics in the higher institutions of learning and the organization of eugenic societies for the study of the subject among the people.

(*d*) The study of genealogy and knowledge of one's ancestors and family traits. The more the normal man becomes interested in his ancestors the more likely he is to want descendants of the right kind.

(*e*) Instruction in parenthood, its adjustments, obligations and practical necessities.

Breeding Rabbits for Fur

A cross between wild and domesticated rabbits, to unite the size of the latter with the gamy flesh and superior fur of the former, is reported by R. Zimmermann in the *Berlin Veterinary Weekly* (Vol. xxxii, p. 213.) The experiment promises to be successful: perhaps the most interesting fact is that the timidity of the wild stock is found in the hybrids, a good evidence of the fact that mental traits are inherited just as physical characteristics are.

ODD PLANT MALFORMATIONS

Reproductions from photographs of material collected by Albert A. Hansen, Department of Botany, The Pennsylvania State College. These peculiar plant formations may be frequently found in the woods or among cultivated plants, and are often a source of wonder and astonishment.

The material here illustrated represents collections extending over a large range of territory, but similar formations may be found in practically every locality. A knowledge of these growths may often be of value to geneticists as an aid to experimental investigations. Frequent as may be the occurrence of these odd plant developments, accurate knowledge concerning them is by no means common.

In literature some of these growths are discussed under such subjects as teratology and malformations, but scientific information concerning their origin and nature is frequently not readily accessible.

Many legends and strange beliefs have centered around plant abnormalities, as, for instance, certain witches' brooms are even to this day popularly regarded as the nests of birds.

DISTORTED CONE OF PINE

Due probably to the fact that the prevailing wind was constantly in one direction during the pollination period, only one side of this cone was pollinated. For this reason, only one side of the cone developed, presenting the strange phenomenon here pictured. Seed will develop only on the pollinated side of the cone. The distortion, of course, is not hereditary. (Fig. 4.)

FASCIATION IN ASPARAGUS

One would hardly recognize the common asparagus in this picture. These peculiarly flattened stems represent a phenomenon termed fasciation, which is not as yet well understood by scientists. It may be caused by fungi, insects, over-nutrition, or a variety of other things. The usual symptom is a much-flattened stem, as may be seen in the above illustration where both the flat and the narrow views are shown. Fasciation may be found in many plants, occurring frequently in the pineapple, the dandelion and the common apple. The flowers are often affected. Aside from distorting the appearance, little harm is done to the plant. Fasciation is sometimes heritable. (Fig. 5.)

WITCHES' BROOM ON BLUEBERRY

These odd malformations, popularly known as witches' brooms, are often caused by the presence of fungous diseases of the type known as the rusts. The presence of the fungus causes the branches to appear in the form of a dense cluster, somewhat resembling a broom. The rusts frequently attack trees, sometimes producing enormous witches' brooms which are erroneously called crow's nests. It is interesting to note that the rusts usually require the presence of other plants in order to complete their life cycle, leading what might be termed a double life. In this case the other plant necessary for the development of the disease is the balsam fir, where the fungus takes on an entirely different form. (Fig. 6.)

ERGOT ON GRASS

The black grains which are so prominent on the head of grass shown above are not grass-grains, but are hardened masses of a fungus called ergot. This fungus contains a peculiar poison which is a frequent cause of abortion in cattle that may be unfortunate enough to eat grass diseased in this manner. A drug commercially known as ergotine is extracted from these hard, black, ergot grains. If the fungus occurs in large enough quantity to make harvesting worth while, the disease may be turned into a source of profit, since the wholesale drug firms offer a ready market for the sale of ergot grains. (Fig. 7.)

PLANT CANCER

The immense protuberance on the above sugar-beet was caused by a plant-disease known as Crown Gall; it was produced artificially in this case by inoculation with the bacteria. In the symptoms and development of this disease there is a remarkable similarity to human cancer. Crown Gall frequently causes the formation of unusual numbers of very fine roots; this gives another common name, "Hairy Root." A large variety of trees and shrubs are subject to this disease, which may appear either on the roots or on the branches; fruit trees are particularly susceptible to attack. Few people realize that bacteria may cause sickness in plants as well as animals. Photograph by courtesy of Dr. Erwin F. Smith. (Fig. 8.)

ORIGIN OF THE FRUIT BRACTS OF THE ALDER

The woody, scaly cone of the common alder is a familiar sight, but few people know that the hard, woody bracts are really modified leaves. In the specimen illustrated, these bracts reveal their true identity, since some of them have become leaf-like, probably a reversion to their ancestral condition. (Fig. 9.)

THE PRESENT STATUS OF INSTRUCTION IN GENETICS

Few Colleges Have Departments Devoted To It—Much Diversity In Methods of Teaching—Growing Tendency To Specialization.[1]

E. E. Barker

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THE breeding of plants and animals always has been, and still is, largely empirical. It is only within the last few years that the experimental science of genetics has thrown light on the phenomena of heredity and has sought to interpret the practices of breeding. Science has followed practice with explanation in this field.

The increasing economic pressure of living conditions is forcing upon us all a recognition of the necessity for higher production under existing conditions—making the two blades of grass grow where only one grew before. The urgent and vital questions that confront us, then, are these: Who are the persons who are going to increase the production by better breeding, and where are they going to find out how to do it? Obviously, the persons will be the actual breeders and farmers, not the professors and experimentalists with their pedigree cultures of primroses and rats and guinea-pigs. The successes and failures of their own work will determine largely their methods. But more and more the breeders and farmers are coming to look to the colleges and experiment stations to supply them with scientific knowledge to guide their practices. So the question is an important one also, how the breeders are being instructed and how the research men are being trained. Furthermore, the importance of heredity in almost every phase and relation of human life is now coming to be so universally recognized that many of us feel no person is liberally and usefully educated unless he has gained the genetic outlook on life. A broad, general course in genetics should be included in the curriculum of every college pretending to provide such an education. The teaching of genetics is, then, a very important item in our educational program at the present day.

These same ideas were expressed five years ago in an editorial in the *American Breeders' Magazine* as follows:

> "The teaching of the science of heredity and breeding, and the training of experts in plant and animal breeding and in eugenics, is rapidly coming into our systems of education. The value of a study that peculiarly combines cultural with vocational values appeals to the student and will bring this subject rapidly into demand, as will also its interest as a phase of biology, which fascinates. Its vital relation to the economic production of farm products and therefore its relation to the cost of living, will make it attractive to students pursuing general and vocational courses not concerned primarily with genetics. Classes in genetics in our colleges and universities will be especially interesting and vital for those preparing for vocations which relate to euthenic betterments."

It was with the purpose of ascertaining how generally these conditions were felt and to what extent these needs were now being supplied that a questionary was recently sent out by the author to many of the leading educational institutions and agricultural experiment stations in the United States and Canada. The replies to this questionary will be summarized briefly in this paper. It must be borne in mind that

[1] Paper No. 57 of the Department of Plant Breeding, Cornell University. Read in New York City at the thirteenth annual meeting of the American Genetic Association, December 26, 1916.

the figures here given are, at best, only approximate, on account of the impossibility of getting full data in all cases, or indeed, any data in some cases. The reader must determine for himself what value he will grant to these figures, since the writer has been unable, himself, to reckon a mathematical probable error for them!

In all, 80 letters were sent out to 73 different institutions, and 61 replies were received. At 51 of these institutions instruction of some sort is offered in genetics. These institutions include the larger Eastern universities, the state colleges of agriculture and many of the agricultural experiment stations that are associated with the state colleges, but do not include the women's colleges or the countless smaller colleges.

LITTLE GRADUATE WORK

In only fifteen of these institutions is any graduate work being done by advanced students in genetics, but over 140 students were registered for graduate work last year. The number of undergraduate students taught is much larger, of course. There are registered this year at these fifty-one institutions in various undergraduate courses where some sort of attention is paid to genetics, approximately 2,700 to 3,000 students. If full data could be had for the many smaller colleges throughout the country where genetics courses are given, this number would be very greatly increased.

The subject of genetics itself is so new as a science, that it is not surprising to find a very large "coefficient of variability" in regard to methods of instruction, and topics treated and the prerequisite courses required. It is impossible, therefore, to summarize these points where no uniformity exists. It would seem that the instruction consists of anything from a more or less superficial consideration of points of breeding, heredity and evolution, discussed incidentally in other courses, all the way to thoroughgoing courses dignified by the name of "Genetics."

Many of the courses, apparently, consist entirely of lectures and discussions, for in only thirty-four courses in twenty-one of the colleges is laboratory work provided in connection with the lectures. Some courses consist entirely of lectures, some combine recitations with the lectures, and some comprise lectures, recitations and laboratory practicums. Most of the courses require certain other courses as prerequisites—either all the work required of regular students up to the junior or senior year, or one or more courses of the following subjects mentioned specifically: Botany mentioned 28 times, Zoology 24, Biology 8, Horticulture 4, Organic Evolution 3, Animal Husbandry 3, Chemistry 3, Crops 3, Cytology 2, Plant Histology 1, Physiology 2, Plant Physiology 1, Vegetable Gardening 1, Plant Propagation 1, Pomology 1, Mathematics 2.

Perhaps some of the less specialized courses are embryonic genetics courses. At any rate, the latter seem to have developed from such beginnings as the former and to have come into being in whichever department circumstances or the personal qualifications of the instructor have made possible their development. In only five institutions is genetics taught in a special department—at Cornell University and the University of Arizona in the Department of Plant Breeding, at the University of California in the Division of Genetics in the College of Agriculture, at the University of Utah in the Genetics Division of the Agricultural Department, and at the University of Wisconsin in the Department of Experimental Breeding. To these may be added Pennsylvania State College which is soon to have a Division of Genetics in the Department of Botany. Elsewhere, the instruction is given incidentally or more or less thoroughly in various departments as follows: Animal Husbandry 19, Zoology 18, Horticulture 15, Agronomy 14, Botany 14, Biology 6, Entomology 2, Geology 1. In connection with Harvard is the Bussey Institution, a special institution for research work in genetics where only graduates and a few advanced undergraduate students are admitted.

Perhaps the best indication of the nature and thoroughness of the courses is afforded by the list of texts and refer-

ences used. There seems to be no book in English that covers the whole subject satisfactorily in a general way, or that is universally suited to the extremely diverse modes of presentation of the various teachers.[2] Perhaps Walter's "Genetics" comes nearest to filling this place, because it is mentioned as being in use at 26 of these 51 institutions. Bailey and Gilbert's "Plant Breeding" comes second, being reported from 12 places; Davenport's "Principles of Breeding" was mentioned by 11; Morgan's two books "Heredity and Sex" and the "Mechanism of Mendelian Heredity" together, by 15; Punnett's "Mendelism" by 7; Thomson's "Heredity" 6; Castle's "Heredity" 5; DeVries' "Plant Breeding" 6; Newman's "Plant Breeding in Scandinavia" 3; Bateson's "Mendel's Principles of Heredity" 4; Jordan and Kellogg's "Evolution and Animal Life" 2; Pearl's "Modes of Research in Genetics" 2; Goldschmidt's "Einführung in die Vererbungswissenschaft" 2. In many courses several of these books are used, and among other supplementary references mentioned were Prof. Lochhead's "Outlines of Heredity and Genetics," the JOURNAL OF HEREDITY, *Journal of Genetics* and other journals; *American Breeders' Association Magazine* and *Reports;* Romanes' "Darwin and after Darwin"; Osborn's "From the Greeks to Darwin"; Kellogg's "Darwinism Today"; Darbishire, Doncaster, and both Darwin's "Origin of Species" and his "Animals and Plants under Domestication." Besides these there is a rather general use of experiment station bulletins.

I am indebted to the Macmillan Publishing Company through the courtesy of their traveling sales agent, B. P. Jones, for some figures that are much more significant than those obtained from the questionary. They include all the small colleges and also the women's colleges where Macmillan publications are used as texts in connection with courses in genetics. According to their figures Walter's *Genetics* is being used this year at 118 places in this country, Bailey and Gilbert's *Plant Breeding* at about 50, and Pearl's *Modes of Research in Genetics* at 9. The genetics courses at these smaller institutions are generally more uniform in character, as the instructor is apt to follow a text-book quite closely.

SPECIALIZATION INCREASING

The trend of organization for instruction in genetics seems to be toward specialization and centralization under trained experts in the science. Indeed, the most efficient system seems to be that of giving a general elementary course, quite theoretical in nature, in some one department, to be followed by more advanced courses in that same department and by courses in other departments where the practical application of the principles here taught is pointed out in regard to breeding specific crops and kinds of animals.

There seems to be need on the one hand of more thoroughly scientific instruction in some of the courses that are of a very "practical" nature, and on the other hand, more emphasis in the theoretical courses on the eminently utilitarian importance of genetics as an applied science. Above all, there is need of a deeper knowledge of the great truths of variation, heredity and evolution and their bearing on our lives, and a better and more thorough way of teaching these facts to the uninformed.

Annual Business Meeting of the A. G. A.

The annual business meeting of the association was held, in accordance with the provision of the by-laws, at 5 o'clock, on Thursday afternoon, January 11, in the home of Alexander Graham Bell, Washington. Reports from the secretary, treasurer and editor were read and approved. The three retiring members of the council, George M. Rommel, T. H. Kearney, and Dr. W. C. Rucker, were elected to succeed themselves.

At the annual meeting of the council, held in the Cosmos Club on Tuesday, January 16, the present officers of the association were re-elected. Dr. Frederick Adams Woods, of Brookline, Mass. was elected a member of the council, vice Dr. Arthur W. Gilbert, of Cornell University, resigned.

[2] This was written before the publication of Castle's "Genetics and Eugenics."

JEWISH EUGENICS

Perpetuation of the Race Explained by Application of Sound Biological Principles —Marriage Held in High Esteem and Its Success Measured by Eugenic Standard

THROUGHOUT its history, the Jewish race has been subject to vicissitudes greater than those which have caused the disappearance of many another people. Yet the Jews have maintained to a considerable degree their racial homogeneity and to a high degree their average of intellectual quality.

Racial survival under such difficulties, and racial continuity in so varied environments, must permit explanation in terms of eugenics, and Rabbi Max Reichler,[1] among other students, has attempted such an interpretation.

"To be sure," he says, "eugenics as a science could hardly have existed among the ancient Jews; but many eugenic rules were certainly incorporated in the large collection of Biblical and Rabbinical laws. Indeed there are clear indications of a conscious effort to utilize all influences that might improve the inborn qualities of the Jewish race, and to guard against any practice that might vitiate the purity of the race, or 'impair the racial qualities of future generations' either physically, mentally, or morally. The Jew approached the matter of sex relationship neither with the horror of the prude, nor with the passionate eagerness of the pagan, but with the sane and sound attitude of the far-seeing prophet. His goal was the creation of the ideal home, which to him meant the abode of purity and happiness, the source of strength and vigor for body and mind.

"The very founder of the Jewish race, the patriarch Abraham, recognized the importance of certain inherited qualities, and insisted that the wife of his 'only beloved son' should not come from the 'daughters of the Canaanites,' but from the seed of a superior stock.

"Abraham's servant, Eliezer, so the Midrash states, desired to offer his own daughter to Isaac, but his master sternly rebuked him, saying: 'Thou art cursed, and my son is blessed, and it does not behoove the cursed to mate with the blessed, and thus deteriorate the quality of the race.' "

"Early marriages were praised as most desirable. Rabbi Ishmael claimed that God was greatly displeased with the man who did not marry before the age of 20. Rav Hunah refused to see Rav Hamnuna, a man of great repute, after the former discovered that his visitor was a bachelor. . . . Among the seven types not acceptable before God are included both the unmarried man and the married man without children."

THE OBJECTS OF MARRIAGE

"The Rabbis, like the eugenists of today, measured the success of a marriage by the number and quality of the offspring. In their judgments the main objects of marriage were the reproduction of the human race, and the augmentation of the favored stock. Hence they advised that an extremely tall man should not marry an extremely tall woman, lest the children be awkwardly tall; nor should one of short stature marry a woman of the same size, lest their offspring be dwarfed. For the same reason, the intermarriage between blonds or be-

[1] Jewish Eugenics and other essays: three papers read before the New York Board of Jewish Ministers, 1915. I, Jewish Eugenics, by Rabbi Max Reichler; II, The Defective in Jewish Law and Literature, by Rabbi Joel Blau; III, Capital Punishment among the Jews, by Rev. Dr. D. de Sola Pool. New York: Bloch Publishing Co., 1916. The lectures are copiously annotated with reference to the original sources.

tween dark-complexioned people was not countenanced."

"Raba advised every young man not to marry a girl before he knew all about her immediate family, especially about her brothers, for 'children usually inherit the traits of their mother's brothers.' "

"The attempt to limit the multiplication of the undesirable elements in the Jewish race resulted in three kinds of prohibitions. First, prohibition against the marriage of defectives by reason of heredity; secondly, the prohibition against the marriage of personal defectives; thirdly, the prohibition against consanguineous marriages.

"Besides the prohibition against defective marriages mentioned in the Mosaic code, the Talmud forbade one to marry into a confirmed leprous or epileptic family, or to marry a woman who had buried three husbands. The union between an old man and a young girl was condemned in unequivocal terms. Persons or families manifesting continuous antagonism to each other were advised not to intermarry. Great, in the eyes of the Rabbis, was the offense of him who married a woman from an element classed among the unfit. His act was as reprehensible as if he had dug up every fertile field in existence and sown it with salt. A quintuple transgression was his, for which he will be bound hand and foot by Elijah, the great purifier, and flogged by God himself. 'Woe unto him who deteriorates the quality of his children and defiles the purity of his family,' is the verdict of Elijah indorsed by God. On the other hand, the mating of two persons possessing unique and noble traits cannot but result in the establishment of superior and influential families. When God will cause his Shechinah to dwell in Israel, only such which have scrupulously preserved the purity of their families will be privileged to witness the manifestation of the Holy Spirit.

REGARD FOR MENTAL TRAITS

"The distinctive feature, however, of Jewish eugenics lies in the greater emphasis laid on the psychical well-being of posterity." The Rabbis relate that when the question came up whether or not the Gideonites should be permitted to intermarry with the children of Israel, David tested them, in order to ascertain not so much their physical fitness but rather their psychical fitness, and found them wanting in three characters peculiar to Israel, namely, sympathy, modesty, and philanthrophy. He, therefore, thought it eugenically inadvisable to allow their mating with a spiritually better-developed stock.

"The Jew took his spiritual mission as representing a 'kingdom of priests and a holy kingdom' quite seriously, and used all possible eugenic means to preserve those rare emotional and spiritual qualities developed during centuries of slow progress and unfolding. Intuitively, he felt the truth, so well expressed by a modern student of eugenics, that 'Religion would be a more effective thing, if everybody had a healthy emotional nature; but it can do nothing with natures that have not the elements of love, loyalty and devotion.' The Rabbis would say: Religion can do nothing with natures that have not the elements of sympathy, modesty and philanthrophy. Hence, they urged that a man should be willing to offer all his possessions for the opportunity of marrying a member of a psychically well-developed family.

"The marriage between the offspring of inferior stock and that of superior stock, such as the marriage between a scholar and the daughter of an *am-haarez*, or between an *am-haarez* and the daughter of a scholar, was considered extremely undesirable, and was condemned very strongly. Moreover, no Rabbi or *Talmid Chacham* was allowed to take part in the celebration of such a non-eugenic union.

"An historical case is cited by Rabbi Eliezer to prove that one should always select his soul-mate from amongst the spiritually better-developed families. Moses married a daughter of Jethro, a heathen priest, and the result was that one of his grandsons, Jonathan,

became an idolatrous priest. Aaron [the brother of Moses], on the other hand, married the daughter of Abinadab, and history records the name of his grandson Phinehas as the hero who defended the honor and purity of Israel."

THE EUGENIC VIEWPOINT

"A parallel to the 'rough eugenic ideal' of marrying 'health, wealth and wisdom' is found in the words of Rabbi Akiba, who claims that 'a father bequeaths to the child beauty, health, wealth, wisdom, and longevity.' Similarly, ugliness, sickness, poverty, stupidity, and the tendency to premature death are transmitted from father to offspring. . . . Thus the Rabbis recognized the fact that both physical and psychical qualities were inherited, and endeavored by direct precept and law, as well as by indirect advice and admonition, to preserve and improve the inborn, wholesome qualities of the Jewish race. It is true that they were willing to concede that 'a pure-bred individual may be produced by a hybrid mated with a pure-bred,' for they found examples of that nature in Ruth the Moabitess, Naamah the Ammonitess, Hezekiah and Mordecai. As a general eugenic rule, however, they maintained that one cannot produce 'a clean thing out of an unclean,' and discouraged any kind of intermarriage even with proselytes. Their ideal was a race healthy in body and in spirit, pure and undefiled, devoid of any admixture of inferior human protoplasm.

"Such an ideal, though apparently narrow and chauvinistic, has its eugenic value, as the following suggestive quotation from a well-known eugenist clearly indicates. 'Families in which good and noble qualities of mind and body have become hereditary form a natural aristocracy; and if such families take pride in recording their pedigrees, marry among themselves, and establish a predominant fertility, they can assure success and position to the majority of their descendants in any political future. They can become the guardians and trustees of a sound inborn heritage, which, incorruptible and undefiled, they can preserve in purity and vigor throughout whatever period of ignorance and decay may be in store for the nation at large. Neglect to hand on undimmed the priceless germinal qualities which such families possess can be regarded only as a betrayal of a sacred trust.' "

A Treatise on Poultry Breeding

POULTRY BREEDING AND MANAGEMENT, by James Dryden, professor of poultry husbandry at Oregon Agricultural College. Pp. 402, illus. New York, Orange Judd Co., 1916. Price, $1.60 postpaid.

Professor Dryden's book contains a fuller and better discussion of the principles of breeding than is customary in books on poultry. He relates the history of the fowl, but seems doubtful whether the Jungle Fowl is the sole ancestor, or whether there are at least two. He points out that the primitive stock lays only 10 to 20 eggs a year, and that prize specimens now lay more than 300 eggs a year; but the census figures showing that the average hen in the United States lays only 80, indicate that there is still room for breeders. He discusses the inheritance of egg-production at length, and says Oregon experiments with White Leghorns indicate that fecundity is inherited from both sire and dam. His account of the evils of inbreeding is painted a little blacker than is necessary, and some of the facts he gives in this connection are susceptible of other interpretation. The fact that the Black Spanish, once a popular egg-laying breed, has become almost extinct because of insane efforts to breed for increased size of white face, indicates that poultrymen have need of enlightenment on scientific animal production, and Professor Dryden's book should exercise a sound influence, while it will prove interesting reading not only to the practical poultry breeder but to all geneticists.

BUD VARIATION IN LEMONS

Tree Grown from a Single Bud Will Produce Several Types of Fruit, Which Can In Turn be Propagated—Importance of Careful Selection of Budwood for Propagation—Profits of Lemon Industry Can be Much Increased by Bud Selection.[1]

A. D. Shamel

Office of Horticulture and Pomology, Bureau of Plant Industry, U. S. Department of Agriculture; Riverside, Cal.

THE study of the remarkable bud variations of the Washington navel orange in California orchards[2] was begun by the writer in 1909. This investigation led to a similar study of the bud variations of other citrus varieties. In 1911, at Corona, Cal., a systematic study of the bud variations of the Eureka lemon (*Citrus limonum* Risso) was begun by the writer and his associates. Later, these studies were extended to include the variations of the Lisbon and Villafranca varieties. The performance records and observations of trees of these three varieties of lemons have all been secured in citrus orchards near Corona. Commercial performance records have been secured by coöperators in several lemon orchards in the different citrus districts of California, so that at the present time there is available for study a large amount of reliable data concerning these varieties and their behavior.

The individual lemon tree performance records are now being prepared for publication by the Bureau of Plant Industry of the U. S. Department of Agriculture. Until this publication has been completed, we will be unable to present the performance records, notes or other data for use elsewhere. For this reason I shall not attempt in this paper to give any details of the results of the investigational work, and will only discuss some general observations in the hope of emphasizing the desirability of further similar systematic investigations of bud variations in citrus fruits grown in other regions, and in all other plants propagated vegetatively.

OBJECT OF STUDY

The object of these studies is to determine the extent and frequency of bud variations in lemon varieties, the comparative commercial value of the various strains arising from bud variations, the development of methods for isolating the best strains and controlling variability in them through bud selection.

Before attempting a scientific study of the causes of bud variability, it was decided to determine definitely the actual conditions in established orchards with respect to bud variation. This study was begun without any prejudice, one way or another, and with little or no knowledge of the phenomena of bud variation in plants.

The work of the writer, previous to taking up these studies, was confined to studies of plants propagated from seed. In order to prevent any possibility of bias in the study of the variability of plants propagated vegetatively, no attempt was made to review the small amount of available literature on this subject. Our observations and con-

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[1] Read by title at the thirteenth annual meeting of the American Genetic Association, New York City, December 27, 1916.

[2] See Shamel, A. D., Bud Variation. Journal of Heredity, Vol. vii, pp. 82–87, February, 1916; Washington Navel Orange, *ibid.*, Vol. vi, pp. 435–445, October, 1915. See also Improvement of California Orange Groves, Journal of Heredity, Vol. vii, p. 493, November, 1916, and Coöperation in Production of California Grapefruit, *ibid.*, Vol. vii, pp. 524–527, November, 1916.

clusions have been made solely from the actual field work of the writer and his associates. The only outside assistance or help used in the course of these studies has been the criticism and suggestions given by those who are interested in the work.

We have recently begun the accumulation of reliable information concerning the origin of valuable agricultural varieties which are known to have originated from bud variations. This information is of value to us chiefly from the fact that it confirms our conclusions as to the utility of bud selection in the improvement of all plants propagated vegetatively.

We use the term improvement here to mean the isolation of valuable strains of established varieties, and the conservation and maintenance of these strains, through bud selection. It is also used to include the origination of better varieties through the selection of bud mutations of particular value. However, we have been inclined to give most emphasis to the standardization and improvement of established valuable varieties, rather than the origination of new varieties. We have no quarrel with anyone working for the development of new varieties, but we feel that the stabilizing of our known and valuable varieties should receive the first and most careful consideration of plant breeders. We do most decidedly differ from anyone who suggests that the origination of new varieties is the most important work, or should be the sole consideration, of those who are trying to improve our agricultural crops.

The making of new varieties and their introduction is a matter which of necessity should be reserved for specialists. The wholesale distribution of new, and oftentimes untried, sorts of plants is frequently attended with disappointment and loss by inexperienced growers.

PLAN OF STUDY

The plan of study pursued in these investigations has been to keep exact records of the amount and the commercial quality of the production of individual lemon trees in orchards where the conditions are particularly uniform and favorable for securing reliable information in connection with this work. Descriptions and illustrations of trees, flowers and plants have been secured for additional consideration and study. In this connection, it should be said that the performance records secured in these studies are from trees located in the best commercial lemon orchards of California. The owners of these orchards, without exception, have furnished most of the labor and borne most of the expense of securing the records, with the exception of those of the writer and his associates. This study has been carried on under very pleasant and favorable conditions, and at a minimum cost by reason of the public spirit shown through the active coöperation of the lemon growers.

The progeny tests of the select trees in performance record plots are being carried out, for the most part, in the same manner. The buds for progeny tests from the select trees, now more than two millions in number, have been furnished to coöperators free of charge by the owners of the select trees, with the understanding that the progenies be kept separate and so labelled that any progeny can readily be traced back to its parent tree. The success of this propagation work up to this time, as shown by performance records, has been the foundation upon which the methods of bud selection recommended for use by propagators have been based.

Usually one hundred trees have been included in a performance record plot. In some cases, a smaller number of trees has been used, where it has been found desirable to study isolated trees, in which case five or more comparative trees have been selected for a plot. The conditions in these plots have always been given careful consideration with particular reference to uniformity of soil and cultural conditions, freedom from variable environmental influences, and the continuous ownership and successful management by the same owners. The trees have been maintained under as nearly comparable conditions as it is possible to secure in practical agriculture.

Regular monthly picks of lemons have

THE GROWER EXPECTED THESE TWO LEMONS TO BE JUST ALIKE.

As progagated by nurserymen, a lemon tree represents the growth of a single bud. It might be supposed that a tree so produced could not bear more than one type of fruit. But observation has shown that many trees bear a wide diversity of types. The two strikingly different types of lemons photographed above, and numerous others, were all borne on a single Lisbon lemon tree. It is of great importance for growers to propagate trees that will come true as far as possible, and that will come true to a good type, not a bad one; this requires selection of propagating material, not only if the trees are grown from seed, but even if they are grown by budding or grafting. (Fig. 10.)

been made from the performance record trees since the beginning of these investigations. The pick of each tree is sorted into various definite and clear-cut grades, and the number and weight of the fruits in each grade have been carefully determined and recorded. The variable fruits from each tree have been sorted, classified, and the number and characteristics of each kind recorded. Any notes as to variable limbs, or other interesting facts of tree behavior have been recorded when observed. with the data from each tree, in regular forms printed in field note-books for this purpose. These data are then transferred to annual performance record forms, arranged for the convenient compilation on one page of all of the picks from a tree during the year. Finally, the annual production data of each tree are transferred to period performance record forms where the summaries of several years' records can be brought together, and where all available information concerning the individual trees can be collected for study.

The lemon performance record data and observations accumulated in these investigations have furnished a large amount of interesting material for study. One or more men have been continuously engaged on this subject from the inception of these studies until the present time. Additional assistance is now needed in order to secure more extensive and adequate progeny records.

SOME IMPORTANT STRAINS

The important strains of the lemon varieties in the performance record plots are distinguished by the habit of growth of the trees; characteristics of the bloom; season and amount of production of the fruits; size, shape and color of the fruits; texture, thickness and appearance of the rind; amount and quality of the juice, and other tree and fruit characteristics.

The habits of tree growth of the various strains include the open, erect, upright, spreading and drooping, and drooping positions of the branches. The habit of growth is usually correlated, in some degree, with the density of the foliage and leaf characteristics. For example, the Eureka tree, having an open habit of growth, usually has a rather sparse amount of foliage, and the leaves are usually of medium size and bluntly rounded in shape. The spreading type of Eureka tree, on the other hand, has characteristically dense foliage and the leaves are usually large and sharply pointed.

One strain of the Eureka lemon, commonly called the shade tree, develops a large percentage of abnormal blooms. In these blossoms, the pistils are rudimentary or absent, so that shortly after blooming, these flowers fall on the ground. The trees of this strain produce an unusually large quantity of flowers, more perhaps, than the trees of any other lemon strain in the performance record plots. The trees of the productive strain of the Lisbon variety yield crops more evenly distributed throughout all seasons of the year than the trees of the dense strain, which bear most of their crop during the spring months. The trees of the productive strain of the Eureka variety have a strong tendency to produce fairly regular monthly crops, while the trees of the shade tree strain produce their crops mostly during the fall months.

VARIED PRODUCTIVITY

The trees of the productive strain of the Eureka variety have produced annually, on an average, more than five times the quantity of lemons produced by the trees of the shade tree strain, under the same conditions. Similar differences in the amount of annual production of other strains of the lemon varieties have been found.

Inasmuch as lemons are picked green when reaching a certain size, which is measured by slipping an iron ring over the fruit, the variation in sizes of fruits borne by trees of the different strains is not so marked as is the case with oranges or other fruits which are allowed to reach full size on the trees. However, the fruits of some lemon strains reach the size required for picking more quickly than those of other strains.

There is a marked correlation in the

shape of lemons and the habit of growth of the trees belonging to the different strains. For instance, the bottleneck shaped Eureka lemons are borne by trees that are finely branched and have very dense foliage characteristics easily discernible to even the most casual observer. The long, cylindrical Eureka lemons are borne by trees having a spreading habit of growth, with large sharply pointed leaves, belonging to an unproductive strain of this variety.

A frequent sport found in the trees of all lemon varieties is variegated fruit and foliage. Such variations have stripes or sections of alternate white and green colors, and the fruits are usually slightly ridged. They occur as single fruits, or as branch variations, and have been successfully propagated in experimental trials. The shade tree strain of Eureka lemons produces fruit with very thick rind, very coarse rag and but little juice—so little, in fact, that in many cases little or no juice can be extracted by ordinary hand pressure. The productive Eureka strain, on the other hand, yields fruit with thin rind, tender rag and an abundance of juice, which is easily squeezed out.

Many other similar differences characteristic of the fruits of the different strains have been observed and recorded. They have been proved to be of fundamental importance in the production of the established lemon orchards of California.

COMPARATIVE VALUE OF STRAINS

The accurate determination of the comparative value of the lemon strains in commercial orchards of the lemon varieties under investigation has been the first consideration in these studies up to this time. With reliable information of this character at hand, a definite idea of the comparative commercial status of any orchard can be determined after the number of trees of each of the known strains in these orchards has been found.

In lemon growing, the season of production of the crop is an important factor in the profitableness of the business. In some seasons of the year, *e. g.*, the summer months, more lemons are consumed than during the winter. For this reason, the strains which produce the bulk of their crops during the summer are usually more valuable than those which produce their main crops during the winter season.

The productive strains, in every case known, produce a higher percentage of first grade or more valuable commercial lemons than the unproductive strains. For example, about 80% of the crop of the trees of the productive strain of the Eureka variety in the performance record plots has been of the best grade, while the unproductive strains have produced only about 20% of the best grade of fruit.

A preliminary survey of the performance record data shows that there has been a great difference in the value of the production of the different strains of the lemon varieties under similar conditions during the entire period of observation. So great is this difference that it frequently accounts for the success or failure of the lemon orchards in California, depending upon the proportion of the different strains in the orchards. It is a striking fact that in all of the unsuccessful and unprofitable lemon orchards, to which our attention has been called, we have discovered a large proportion of undesirable strain trees, reaching as high as 90% of the total number of trees in some orchards. On the other hand, the most profitable and successful orchards studied have been found to contain, without exception, a large proportion of productive strain trees.

ORIGIN OF STRAINS

The evidence that the strains of the lemon varieties found in these investigations have originated as bud variations may be mentioned under two heads. First, individual fruit variations or branches bearing several fruit variations, corresponding to all of the known strains, have been found repeatedly in standard type trees in the performance record plots. Frequently, several strains are represented by typical fruits and foliage in the same tree grown from a single bud. Second, many experimental

propagations from branch sports have been made in these studies, and so far, the buds from these striking limb variations, representing all of the known strains, have reproduced the characteristics of the limb sports. Enough propagations of this character have been made to prove that all of the known strains of the lemon varieties can be propagated in this manner.

From this, and other available evidence, it would seem reasonable to conclude that the different lemon strains in the established orchards have been propagated, often unintentionally, from bud sports.

FREQUENCY OF BUD VARIATIONS

In June, 1912, the writer and his associates made a tree census study of a lemon orchard containing about 16,000 trees which were 8 years old. It was found in this work that 3,200, or 20% of the trees in this orchard, were of the undesirable shade tree strain. A similar study was made a little later of a 10-acre Eureka orchard 20 years old, from which the buds were secured for the propagation of the larger orchard. It was found that among the 800 trees in this orchard about eighty, or 10%, were of the shade tree strain. In seeking an explanation for the increase in percentage of the shade trees in the younger orchard, it was learned from the propagator that, owing to the larger number of sucker branches formerly used for propagation purposes (the rapid growing and non-fruit-bearing limbs) in the shade trees as compared with the number of such branches in the productive strain trees, a larger proportion of the budwood used for the propagation of the younger orchard had been cut from the shade trees than from the productive trees. Inasmuch as no distinction was made between the shade trees and the productive trees, and as sucker growth was considered at that time to be just as good as fruit-bearing growth for propagation, it was natural that the bud cutters should secure a larger proportion of budwood from the shade trees than from the productive trees.

This experience, in common with many similar ones in other orchards, is convincing evidence of the widespread mixtures of strains in established orchards. It also throws light on the reason why many of the younger lemon orchards have been found to contain a larger proportion of the vigorous growing unproductive trees than the older ones.

DIFFERENCES IN YIELD

The trees of some strains of the varieties of lemons studied, have been found to be more prolific in the production of strikingly variable fruits and foliage than others. For instance the productive strain trees of the Lisbon variety have been found to be comparatively free from the presence of sports, while the trees of the bastard strain have been found to be particularly prolific in the production of strikingly variable fruits, foliage and other tree characteristics. The productive strains of the Eureka and Villafranca varieties have been found to be comparatively free from sports, although some of the productive strain trees in all of the varieties observed, have been found to produce striking variations.

In the studies of lemon orchards where this matter has received particular attention, variations of fruit or foliage characteristics have been observed in about 75% of the trees. Some orchards have been found to contain but few trees showing variations, while others have a large number of trees producing such variations. The number of variations found in orchards depends largely on the number of trees belonging to the strains which produce a high percentage of variable fruits.

The frequency of bud variation in lemon varieties is much greater than has heretofore been thought to be the case. The continued study of this condition has led to the discovery of many variations which had not been noticed before. In fact, the frequency and importance of the bud variations of the lemon can only be appreciated by those who have become familiar by actual experience with the strains, the

trees, and their habits of growth and production.[3]

One of the factors contributing to the success of the California citrus industry has been the elimination by the growers of a great many varieties of questionable value, and the adoption of a few standard varieties. These include a winter ripening orange, the Washington navel; a summer orange, the Valencia; a seedless grapefruit, the Marsh; and two important varieties of lemons, the Eureka and Lisbon. This action has led to the establishment of a valuable reputation, in important markets, for standard California citrus fruits.

The next step in this connection is the elimination of all of the undesirable strains of standard citrus varieties that have been introduced in the citrus orchards, unintentionally for the most part, through lack of systematic and careful bud selection. This possibility has been clearly and umistakably shown to be practicable by the studies and demonstrations which have been carried on in these investigations. It seems probable that, sooner or later, in the case of lemons, one variety will be adopted and not more than two or three strains of this variety be used in commercial orcharding. These strains, varying in season of heavy production, will produce crops during the entire year, and will enable the growers to establish a more valuable reputation among consumers, for a standard California lemon.

PROGENY TESTS

After considering the behavior of individual lemon trees, and selecting the most desirable ones, the final test of the value of the trees to be used for propagation purposes is the behavior of their progenies. There is some evidence at hand which shows that the progenies of some parent trees are more uniformly like the parents than others. In other words, there is little doubt but that parent trees differ in the extent to which they transmit to their progenies a tendency to variability. In the many progeny tests of select trees, now under way in California, it is believed that some particularly good parent lemon trees for propagation will be discovered. The buds from such trees, where performance records of one or more progenies have been secured, may be said to be truly pedigreed buds.

Annual Meeting in New York Successful

The three sessions of the Association's annual meeting in New York City, December 26 and 27, were attended by about 200 people. Sixteen papers were presented by their authors, and five were read by title. A report of the meeting is to be published in *Science*. A fourth session was held jointly with the Botanical Society of America. In accordance with the decision of the A. A. A. S., the next meeting of the American Genetic Association will be in Pittsburgh, December 28–30, 1917.

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[3] My associate, C. S. Pomeroy, has called my attention to the fact that Samuel B. Heiges, a former pomologist of the U. S. Department of Agriculture, recognized the importance of bud variation as early as 1894. On p. 34 of his report for that year, under the heading "Improvement of Strains," he says: "It is a well-known fact that certain varieties of fruits are subject to influences resulting in modification more or less valuable. For want of a better term these new forms have been called strains. Upon the line of improvement of fruits through selection of strains, but little practical work has been done, and it is desirable that the attention of nurserymen and others be directed to the importance of propagating from their best strains, thereby improving the quality of fruits in the same manner that the stock breeder has improved breeds of domestic animals. Without attempting to wholly explain the cause of this variation, it may be stated that much of it is due to bud variation, and this may be perpetuated intentionally or otherwise by the removal of scions for propagation."

After further consideration of this subject and the citation of several cases of well-known bud sports, Mr. Heiges concludes by saying: "It is believed that as great improvement is possible along the line of selection of strains as by the endless multiplicity of new varieties, the great majority of which are not equal in value to those already under cultivation."

"SOMATIC SEGREGATION"

A Misleading Term, Not Warranted by Knowledge of the Facts—The Alleged Somatic Segregation in Calyx of Pear—Probably to be Explained as a Result of Hybridization

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THAT the proper use of terms is essential to mutual understanding among scientists is too patent to require argument. Many of the disputations that have occupied the time of investigators have arisen through the use of the same term in a different sense or of misleading expressions in referring to commonly recognized phenomena. The literature of genetics, like that of other developing sciences, has not been free from the confusion arising from misuse of terms. In the interest of common progress the authors feel that the time has arrived to call attention to one misleading expression which has come into rather general use, especially among horticulturists. We refer to the use of the term, *segregation*, in designating *somatic* phenomena. This term in Mendelian inheritance means the distribution of allelomorphic factors among the gametes formed by a hybrid organism, half of the gametes receiving one and half the other member of each allelomorphic pair. The mechanism by which this segregation is accomplished is the separation of whole chromosomes in the heterotypic mitosis (meiosis) during the maturation of the germ cells. Unfortunately the term has also been used in referring to the result of the *recombinations* of allelomorphs in hybrid progeny and this looseness probably has led to the wider departure from the strict meaning of the term mentioned above. Some writers as, for example, Kraus[1] in his recent paper on somatic segregation, appear to use the terms segregation and mutation rather loosely. Thus, according to Kraus, "vegetative variations are first of all of two distinct sorts—modifications or fluctuations, which do not remain true when propagated and subjected to varying conditions, and segregations or mutations which may be propagated and expected to remain reasonably constant under a wide range of conditions." It is perhaps hardly necessary to point out that modifications and fluctuations are no more truly synonymous than are segregations and mutations, since some fluctuations are attributable to other causes than environmental effects.

BATESON'S SUGGESTION

Bateson[2] first suggested the possibility that segregation might sometimes occur during somatic mitosis. But although cytologists have demonstrated several irregularities in chromosome behavior during meiosis (when homologous chromosomes normally become dissociated and distributed to different gametes) there is no evidence that chromosome irregularities occur during ordinary cell divisions in embryonic or meristematic tissues, where it would be necessary for segregation to occur in order to produce profound somatic changes. It is conceivable, of course, that the division by longitudinal split-

[1] Kraus, E. J. Somatic Segregation. Journal of Heredity, VII, 1, 1916.

[2] Bateson, W. Mendel's Principles of Heredity, 1909, pp. 272–3.

ting might occasionally deviate from the regular method by which each chromosome is exactly halved, but the observations of many investigators indicate that mitosis in undifferentiated tissues certainly proceeds with remarkable precision and regularity. Nevertheless, the idea of "somatic segregation" has become fixed in many minds; so much so, indeed, as to make it apparently the most convenient term with which to "explain" many variations, especially in plants. Even true vegetative mutations resulting in chimeras and bud sports have been attributed to "somatic segregation," Bateson[2] having originally proposed this explanation of the production of nectarines on peach trees. This hypothesis assumes that the smooth skin of the nectarine is due to the loss of a unit character possessed by the peach. But on this basis, Bateson was unable to explain the reported production of peaches by a nectarine tree. How could a unit character once lost be recovered again? Clearly the only rational explanation of these phenomena will be expressed in terms of reversible chemical changes in genetic factors. Based on this conception of germinal variations it appears that *somatic mutations*, like germinal mutations, *are caused by alterations in specific factors which occur without the intervention of any known irregularity in chromosome behavior*. As examples from the abundant evidence in favor of this view, the researches of Morgan and his associates[3] on the pomace fly, *Drosophila ampelophila*, have demonstrated that germinal mutations are due to specific factor changes, and Emerson[4] in his study of the inheritance of variegation in maize has shown that bud mutations also, must be due to alterations in specific factors.

Hence, those who accept the chromosome and factorial hypotheses of heredity find it unnecessary to resort to the conception of "somatic segregation" in order to explain bud sports and chimeras. In fact the employment of this expression seems to be actually misleading. Besides, there is a tendency to resort to this conception in attempting to explain other variations in individual plants which can be more reasonably accounted for on some other basis. A case in point is the occurrence of deciduous and persistent calyx lobes in pome fruits.

AN ILLUSTRATIVE CASE

Tufts[5] examined 5,496 fruits from a single tree of Le Conte pear and 56 fruits from a tree of Transcendant crab and noted whether the calyx lobes were deciduous or persistent. In the case of the pear it was found that 3,780 fruits had all the calyx lobes deciduous while 1,616 had one or more lobes persistent. Of the crab fruits, 32 had all calyx lobes deciduous and 24 had one or more lobes persistent. We shall consider in detail only the data from the pear. The 1,616 fruits were classified according to the number of persistent lobes present as follows: 5 P (*i. e.*, with 5 persistent lobes)—773; 4 P—116; 3 P—200; 2 P—289; 1 P—238.

Without considering the significance of the ratio of 3,780 fruits having all lobes deciduous to 1,616 fruits having one or more persistent, Tufts reduced his data on the basis that each of the five carpels found in every normal pear, with its corresponding calyx lobe, is an "individual." Thus the 238 fruits having one persistent lobe were taken as 5 x 238 or 1,190 individuals, 238 of which had persistent lobes and 4 x 238 or 952 had deciduous lobes. By this method he derived the frequencies 21,235 deciduous to 5,745

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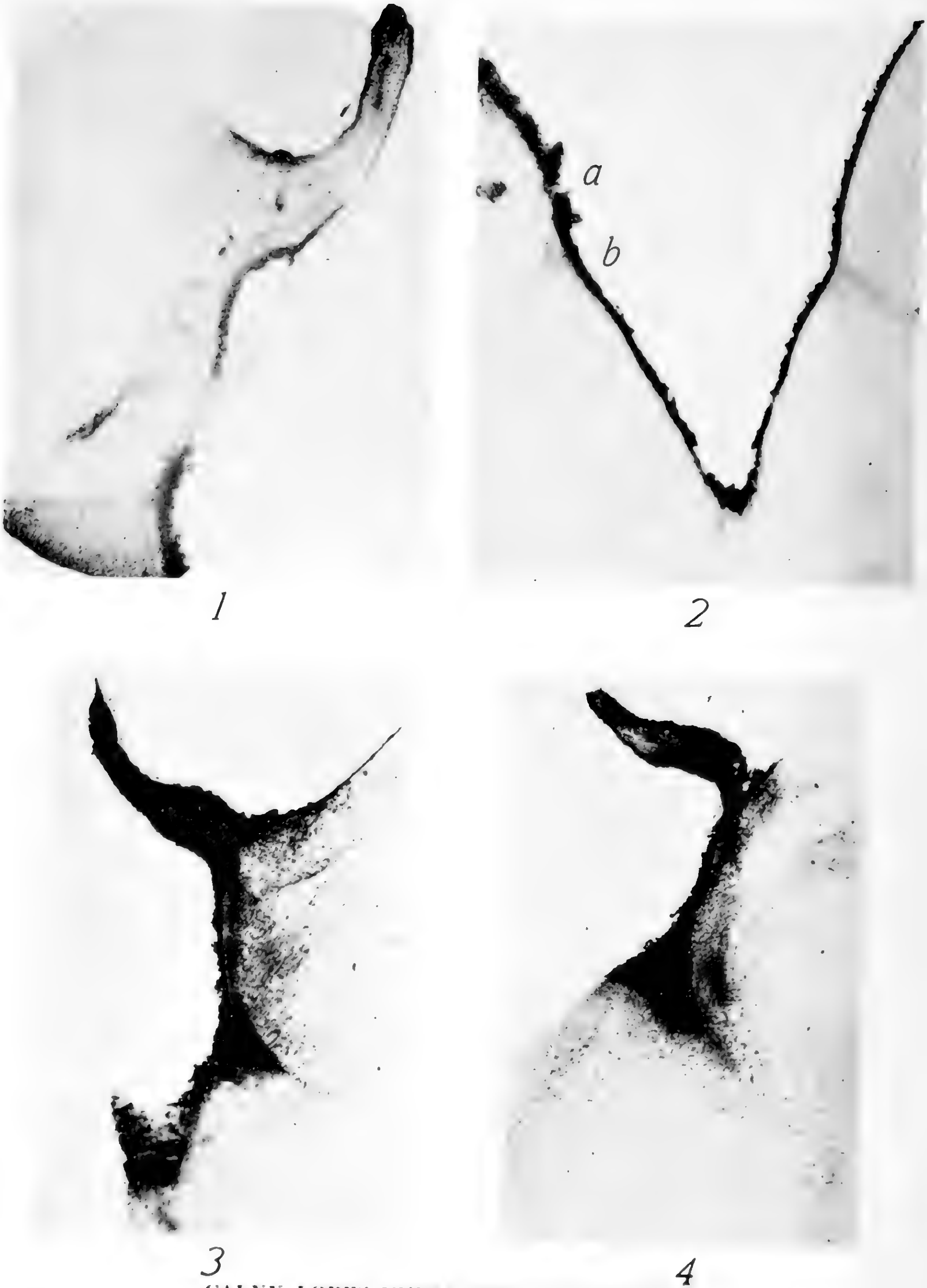
[3] Morgan, T. H., Sturtevant, A. H., Muller, H. J., and Bridges, C. B. The Mechanism of Mendelian Heredity, 1915.

[4] Emerson, R. A. The Possible Origin of Mutations in Somatic Cells. *Amer. Nat.* 47. 1913.
The Inheritance of a Recurring Somatic Variation in Variegated Ears of Maize. *Amer. Nat.* 48 and *Nebraska Agr. Exp. Sta. Research Bull.* 4. 1914.
Anomalous Endosperm Development in Maize and the Problem of Bud Sports. *Zeits. f. ind. Abstam. u. Vererb.* XIV, 5. 1915.

[5] Tufts, W. P. An Inquiry into the Nature of a Somatic Segregation of Characters in the Le Conte Pear. *Oregon Agr. Exp. Sta. Bull.* 123. 1914.



CALYX LOBES UNDER THE MICROSCOPE

The above photomicrographs show longitudinal sections of calyx lobes and the adjacent ovary wall, magnified from 20 to 30 diameters. (1) Section of a persistent lobe showing secondary thickening of base of lobe, secondary growth in parenchyma near its base and the triangular cross-section of a zone of small cells. (2) Ovary wall showing zone of small cells (*b*) and remnant of stamen filament (*a*). (3) A persistent lobe. (4) The same lobe showing partial exfoliation. (Fig. 11.)

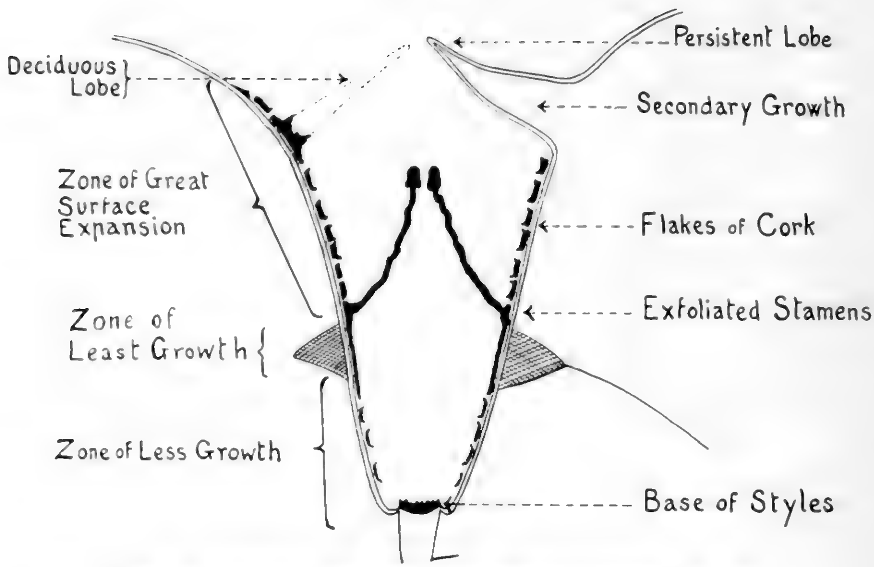
persistent. This ratio was taken to be 3.7:1 which was considered a fairly close approximation to the theoretical Mendelian monohybrid ratio. This incorrect statement of the frequency-ratio makes the deviation from the ideal appear much larger than it really is. When calculated on the basis of fours, the ratio of the relative frequencies is 3.15:0.85. But even when stated correctly, this ratio has a highly significant deviation from the theoretical ratio in view of the large number of individuals examined. Had the ratio of the frequencies of entire fruits (2.8:1.2) been considered, the deviation would not have been quite so serious. Yet even here, the deviation is 12.5 times the probable error, so that the odds against such a deviation occurring *where the laws of simple sampling prevail*, as they do in normal Mendelian inheritance, are approximately 1,155,000,000,000,000 to 1. Hence the observed frequencies are hardly attributable to conditions prevailing under the laws of simple sampling. Therefore, if we attach any significance whatever to the observed ratios of persistent to deciduous lobes we must infer that this case of apparently alternative, discontinuous variation can be explained more reasonably on some basis other than the existence of a segregation-mechanism in somatic cell division.

However, too much importance must not be attached to even as decisive a mathematical objection as the present case affords. It must be remembered that in hybrid progenies, wide deviations sometimes occur in the observed frequencies of characters which exhibit clear cut alternative inheritance. For example, Collins and Kempton[6] obtained an average ratio in a series of crosses between Chinese corn with waxy endosperm and American varieties with horny endosperm that displayed a deviation from the expected ratio of over nine times the probable error, which might not occur oftener than once in over a million times under the conditions of simple sampling. Yet the two characters are "definitely alternative, the seeds being either waxy or horny, with no intermediates."

EXAMINATION OF NEW MATERIAL

The question then arises: What is the real nature of these phenomena of persistency and deciduousness of calyx lobes in apples and pears? Can evidence be found that will throw light on the conditions which induce them? Upon examining several fresh fruits obtained in August, 1916, through the courtesy of Prof. V. R. Gardner from the trees of the Le Conte pear and Transcendant crab that Tufts studied, we have found that when separation of calyx lobes takes place the method is identical with that which occurs when the stamens are loosened. The cells in the basal portion of the calyx lobe fail to grow as rapidly as the cells of the subjacent tissue. In consequence, the epidermis is ruptured near the base of the lobe, peridermal activity supervenes, the deeper tissues are gradually transformed into corky tissue and the lobe finally falls away. In other words, exfoliation of the calyx lobes occurs when two conditions are fulfilled, viz, (*a*) when there is little or no secondary thickening of the calyx lobes themselves and (*b*) when there is sufficient secondary growth in the parenchyma underneath the bases of the calyx lobes and at right angles to their axes. In the photomicrographs shown herewith, the antithetical conditions are clearly shown. Fig. 11, 1 is a longitudinal section through a persistent calyx lobe and adjacent ovary wall of Transcendant crab, showing secondary thickening of the base of the lobe and a conspicuous zone, triangular in cross-section, of small cells which is nearer the bottom of the basin than the points of insertion of the stamens. In marked contrast to this zone of small cells are the large cells of the second growth parenchyma. Fig. 11, 2 shows the location of the base of the filament of an exfoliated stamen

[6] Collins, G. N., and Kempton, J. H. Inheritance of Waxy Endosperm in Hybrids of Chinese Maize. In *IV Conf. Internat. Genetique, Paris, Compt. Rend. et Raps.*, 1911, p. 356.



CALYX LOBES AND THEIR SURROUNDINGS (Fig. 12)

at *a* in relation to the triangular zone of small cells just below at *b*. Figs. 3 and 4 are two sections through the same calyx lobe showing partial exfoliation.

It is desirable that a more thorough histological examination be made of more favorable material, *i. e.*, of younger fruits, taken preferably before the calyx lobes begin to "shear off" as well as later. But the evidence at hand is sufficient to warrant the statement that true abscission, either with or without the formation of an abscission layer, does not occur; and that exfoliation of the calyx lobes is presumably a continuous process, although apparently discontinuous.

The process of exfoliation is illustrated by the accompanying diagram. (Fig. 12.) The region of greatest growth and consequent surface expansion extends from below the stamens upward and beyond the calyx lobes. If the secondary growth of the cells in a calyx lobe is retarded it must suffer the same fate as the stamens.

Partial or incomplete exfoliation is probably more frequent than would at first appear. In specimens of both pears and crabs, dead stamens were still adhering to the basin wall below the persistent calyx lobes, and the tips of these lobes are usually dead. Persistence of a lobe appears to depend upon the extent of secondary thickening of its basal region.[7] In the case of the lobe shown in Fig. 11, 3 and 4, exfoliation had begun at one edge, but there was sufficient secondary growth within to prevent its complete separation from the ovary wall. This indicates that the process of exfoliation is really continuous rather than discontinuous. It is probable that with sufficient material all stages of partial exfoliation would be found in persistent lobes. However, the matter of continuity or discontinuity

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[7] In a variety found on the market in Montreal, the pit was very shallow. On microscopic examination it was found that there had occurred very little secondary growth, so that for the most part the original epidermis had not been disrupted, except for a short distance below the calyx. The triangular zone of small-celled tissue extended from the bases of the stamens quite to the bottom of the pit. No case of exfoliation of the calyx lobes could be found. It is evident that the accompanying diagram represents adequately only a condition of maximum superficial growth.

may not be of much significance in this case, since continuous variation is a normal feature of the expression of some single genetic factors. Moreover, Jennings,[8] in his recent contribution on heredity, variation and the results of selection in *Difflugia corona*, reaches the general conclusion that a single stock, derived by fission from a single progenitor, gradually differentiates into hereditarily diverse stocks, so that by selection marked results are produced. In discussing his results, he points out that while large steps do occur, "much more frequent are very slight inherited changes, not fully inherited, and giving a slow alteration of the stock with the passage of generations." Also that, while an inherited variation does involve a chemical change, "the question of continuity or discontinuity in the nature of hereditary variation is not one of observed fact."

NECESSARY ASSUMPTIONS

With reference to the point at issue, as to whether or not this may be considered a case of "somatic segregation," we find that certain fundamental assumptions are implied by an affirmative decision in the matter. Because something like a 3 to 1 ratio happens to be found in the relative frequencies of deciduous and persistent calyx lobes on a certain tree, is this a good reason for concluding that "somatic segregation" has taken place in that plant? To reach such a conclusion from the given premise, it is necessary to assume three things: (1) The tree must be a hybrid between two forms, one of which was homozygous for a factor for deciduous lobes, the other for persistent lobes. (2) One of each of these factors must be present normally in each cell of the hybrid plant. (3) Since we know that exfoliation of a calyx lobe is conditioned by failure or retardation of the secondary growth of the cells of the lobe, we must assume that in about one-fourth of the lobes on this tree the cells lack the dominant factor, and that this abnormal distribution of factors (and hence chromosomes) takes place previous to the mitotic divisions which occur during the development of the lobes.

In regard to the first assumption, Tufts points out that it is commonly thought that the Le Conte pear is a hybrid between *Pyrus sinensis* and *P. communis* and we may grant the assumption. However, it is interesting to note that *P. sinensis* is described as not entirely constant in its character of having *deciduous* calyx lobes, while according to Tufts' list of varieties about 30% of the seedlings of *P. communis* are also inconstant as regards the character of *persistent* calyx lobes. But inasmuch as some unit characters are variable in expression we may let the first assumption stand for the sake of argument. The second assumption follows of necessity, if we admit that the Le Conte pear is a sexually produced hybrid. It is in regard to the third assumption that we must take issue. The general regularity of the process of mitosis is sufficient argument against it. While an occasional aberration in chromosome behavior might occur in somatic cell divisions, the occurrence of thousands of such irregularities in the same individual, year after year, is hardly conceivable.

Therefore we must reject "somatic segregation" as an expression for the designation of phenomena of this sort. Whether a brief general expression can be formulated which will truly represent the facts in this particular case remains to be seen. We may, at least, attempt to state an explanation which is in harmony with the facts of variation.

In the first place, it must be recognized that variability is not necessarily of genetic significance, particularly in such variations as occur in the expression of a character in a single individual. Character expressions may be variable in pure races and also in F_1 hybrids which are heterozygous for a single allelomorphic pair. Examples of varia-

[8] Jennings, H. S. Heredity, Variation and the Results of Selection in the Uniparental Reproduction of *Difflugia corona*. *Genetics*, Vol. 1, No. 5, 1916.

tion in the expression of a single genetic factor are found in *Antirrhinum* and *Drosophila*. In the former Baur[9] discovered a factor which in pure races conditions the production on the same stem of zygomorphic and peloric flowers. Morgan[3] has reported two factors in the pomace fly, viz, for abnormal abdomen and supernumerary legs, which vary in their expression in direct relation to certain elements in the environment. Examples of variability in simple F_1 hybrids also occur in *Drosophila*. Morgan[3] describes a dominant mutant character, bar eye, in which the normal, roundish eye of the wild fly is replaced by a narrow, bar-shaped organ. In the heterozygous condition the shape varies from almost round to nearly typical bar, but the F_2 ratios prove that bar eye is conditioned by a single factor. Again in *Nicotiana tabacum* there is a variety *calycina*, which produces abnormal flowers. When crossed with another variety having normal flowers the great majority of the flowers in F_1, according to Clausen and Goodspeed,[10] are normal, but some abnormal ones occur and these fill in a continuous series from the normal type to flowers almost as abnormal as *calycina*. None of these variations in character expression is of genetic significance.

EFFECT OF HYBRIDIZATION

But there is another aspect of variation which may well be considered with reference to the case in hand. It is well known that complex hybridization may sometimes increase the variability of characters in F_1 individuals. A single illustration must suffice. When *Nicotiana tabacum* var. *calycina* is crossed with *N. sylvestris* the F_1 plants exhibit a much higher development of the calycine character than appears in F_1 hybrids of *calycina* with other *tabacum* varieties. Also all degrees of the calycine character appear on the same plant, from flowers having only a very slight petaloid tendency in one calyx lobe to those exhibiting the full calycine character.

Now the deciduousness and persistency of the calyx lobes in the Le Conte pear and Transcendant crab might be referable to either of the two aspects of variation described above. The variability in the parents and the variability in F_1 individuals may be a normal feature of calyx lobe development. Hence persistency and deciduousness of calyx lobes are not necessarily to be considered as absolute, alternative characters, as Tufts assumed, since it is possible that they are merely fortuitous variations in degree of development.

On the other hand, pomologists generally consider these varieties to be interspecific hybrids. Moreover, in each case one of the supposed parents is known to have deciduous or mostly deciduous lobes, and in the case of the pear the other supposed parent is characterized by persistent lobes. It is not unlikely, then, that each parent contributed one or more factors for its characteristic condition of the calyx lobes. But since these varieties are complex hybrids it would be expected that a somatic condition already variable in the parents would exhibit even greater variability in F_1 offspring. Other crabs of the Transcendant group also exhibit great variability as to adherence of the calyx lobes, as does also the Kieffer pear, which is considered to have the same hybrid origin as the Le Conte. If the original crosses or similar ones were repeated, quite different ratios might be observed. If other trees of these varieties should be examined, wide variability in the ratios might be found, although all the trees of a given variety belong to the same clone. The difference found would be attributable to environmental effects, including effect of stock on scion, or to vegetative factor mutations, but not to "somatic segregation." The authors believe that increased variability due to complex heterozygosis explains the phenomena in question.

SUMMARY

1. The term "somatic segregation" is considered to be misleading, it since

[9] Baur, E. Einführung in die experimentelle Vererbungslehre, 1914, p. 106.

[10] Clausen, R. E., and Goodspeed, T. H. Hereditary Reaction-system Relations—An Extension of Mendelian Concepts. *Proc. Nat. Acad. Sci.* 2, April, 1916, p. 240.

implies a mechanism for segregation in somatic mitosis.

2. Bud sports and chimeras are attributable to somatic mutations. These, like germinal mutations, are caused by specific factor changes which occur without any known irregularity in chromosome behavior.

3. In the case of deciduous and persistent calyx lobes in the Le Conte pear and Transcendant crab it is shown:

(*a*) That exfoliation of a calyx lobe is conditioned by failure or retardation of the secondary thickening of the lobe.

(*b*) That to assume "somatic segregation" in the case of nearly one-fourth of the calyx lobes on a tree is impossible in view of the general regularity of the process of mitosis.

(*c*) That deciduousness and persistency are not necessarily inheritable variations.

(*d*) That a reasonable explanation of the phenomena in question is that of increased variability in an already variable character due to the complex hybrid nature of the varieties in question.

New Publication Devoted to Mental Hygiene

The National Committee for Mental Hygiene has undertaken the publication of a quarterly magazine of about 160 pages, with the title "Mental Hygiene," the first number dated January, 1917. Its scope is announced as follows:

"*Mental Hygiene* will present to a wide circle of readers in as non-technical a way as possible articles on the practical management of mental problems in all relations of life. Today, as never before, attention is being directed to mental factors in the problems of the individual and of society. These factors are of paramount importance in the study and practical management of delinquency, crime and inebriety. We no longer ignore the fact that education must meet the needs of children who present special difficulties of adaptation. The widespread determination to control feeblemindedness raises questions of economics, law, and medicine which demand the most thoughtful consideration. New ideals in the care and treatment of those suffering from mental disorders are imposing new obligations upon the public authorities. The recognition of preventable causes of mental diseases challenges us to seek in the field of mental hygiene victories comparable to those achieved in general hygiene and sanitation.

"*Mental Hygiene* will bring dependable information and a new inspiration to every one whose interest or whose work brings him into contact with problems of this kind. No other periodical exists for the express purpose of serving these ends. Of interest to all thoughtful readers, to physicians, lawyers, educators, clergymen, public officials, and students of social problems, the magazine will be of especial value."

Material for Plant Breeders

Plant breeders will find a great deal of valuable material described in the Sixth Annual List of New Plant Introductions, which was issued this month by the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C. More than 500 species and varieties of plants, most of them of economic importance or relatives of economic plants, are listed. Seeds or rooted plants can be supplied to those who are interested either in breeding new forms or in testing new introductions. It will be necessary, however, to apply at once, since the amount of material available is in many cases limited, and none is carried over from season to season. All those who are interested in new plants and have room to grow them should write for this list.

SELECTION IN PURE LINES

Many Experiments with Different Characters of Lentil, Vetch, Bean, Pea, Mustard and Oat Fail to Show Any Permanent Modification of Characters—Pure Lines in Self-Fertile Plants Probably Unalterable by Selection

Prof. Dr. C. Fruwirth

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PURE line is the name given by Johannsen to the self pollinated descendants of a self pollinated plant. The name "vegetative line" was applied by me to designate the descendants by vegetative propagation of a single plant[1]—what Webber has called a clon.[2] The word "line" has also been used in various other ways, and in genetic literature nowadays it is, therefore, necessary to specify what one means, when one employs this term. In the present paper I shall use it throughout in the sense given it by Johannsen.

In a pure line of this sort, Johannsen himself made the supposition that selection is powerless to change the hereditary factors. His experiments with beans and barley gave him the basis for this supposition.

During recent years his supposition has been called in question in this magazine, as for instance, by Belling[3] and Castle,[4] while A. and C. Hagedoorn[5] have written in defense of it.

Personally, I decided years ago, as the result of various experiments of my own, that Johannsen was correct in saying that selection cannot alter the character of a pure line. These experiments were made with garden or culinary peas (*Pisum sativum*) selection being directed toward increasing or decreasing the number of pods per plant, and to increasing or decreasing the per cent weight of peas as compared with the weight of the whole plant.[6]

Lately I concluded a series of experiments on the same subject, with a view also to determining the frequency of spontaneous variations (mutations). Concerning the effect of selection, the following kinds of characters were examined:

1. External characters, showing qualitative variations (in snap beans and white mustard) or small quantitative variations (in peas and lentils);
2. External characters showing very large quantitative variations (in oats);
3. Internal characters showing very large quantitative variations (in oats).

1. The pure lines studied under the first head have all been bagged before flowering, in every generation, and were therefore self-pollinated. The pure-line selections (which alone are considered in this paper) were preceded in each case by mass selection in the same direction, and all the plants used to continue the line were protected against cross-fertilization.

RESULTS OF TRIALS

The results of these trials may be summed up as follows:

(*a*) In eight generations of selection with a lentil (*Lens esculenta*) called the Krain lentil, which has seeds in part solid brown in color and the rest black spotted—both kinds of seeds appearing also on the same plant; *I failed* to bring the black spots to full heredity, or even intensify their heredity; and on the other hand selection of plants with no

[1] Fruwirth: Die Züchtung landw. Kulturpflanzen, I, 4th ed., p. 14.
[2] *Science* (New York), 1913, p. 501.
[3] *American Breeders' Magazine*, III, p. 311.
[4] The Journal of Heredity, V, p. 93.
[5] *American Breeders' Magazine*, IV, p. 165.
[6] Fruwirth: Untersuchungen über den Erfolg u. die zweckmässigste Art der Durchführung von Veredlungsauslese bei Pflanzen von Selbstbefruchtern. *Archiv Gesellschaft*, Berlin, 1907.

spotted seeds whatever failed to produce a strain with unspotted seeds.

(*b*) In nine generations of selection with a vetch (*Vicia sativa*) having green and creamy seeds, both, also, on the same plant, *I failed* to obtain either full heredity of the green color, or even a higher percentage of green-seeded plants.

(*c*) In nine generations of selection with snap beans (*Phaseolus vulgaris*) of the variety called green Chevrier, which bears also on the same plant solid green seeds, solid white seeds, and seeds which are part green and part white, *I failed* to bring the green color to full heredity or even to intensify its inheritance.

(*d*) In ten generations of selection of a fodder pea (*Pisum arvense*) called in the United States the Canada pea; the variety being that called with us the black-hulled pea—a variety with yellowish-green seeds with sometimes a tinge of violet; *I failed* to get the violet tinge expressed over a greater area of the seeds of the selected plants or to be produced on all the seeds of the selected plants.

(*e*) In six, seven and eight generations of selection of another lentil (*Lens esculenta*) called the Puy lentil, bearing green seeds marbled with black, the marbling being sometimes so intensified as to produce an almost solid black seed; *I failed* to get plants which would transmit the full black color of seeds or even an intensified marbling. On the other hand, selection of plants with only normally marbled seeds failed to prevent seeds with intensified marking from appearing from time to time.

(*f*) In six generations of selection of white mustard (*Sinapis alba*) where the seeds are normally white (strictly speaking, the color is yellow, despite the name), but where some plants produce brown seeds, some others yellow seeds, and again others produce seeds of both colors, *I failed* to establish full heredity of either of the colors by selecting plants bearing only seeds of the one color.

Here were six careful and persistent attempts to change the character of a pure line by selection of variations in one direction. Not one of these attempts yielded the result hoped for. The pure lines seemed to be unchangeable by selection.

EXPERIMENTS WITH OATS

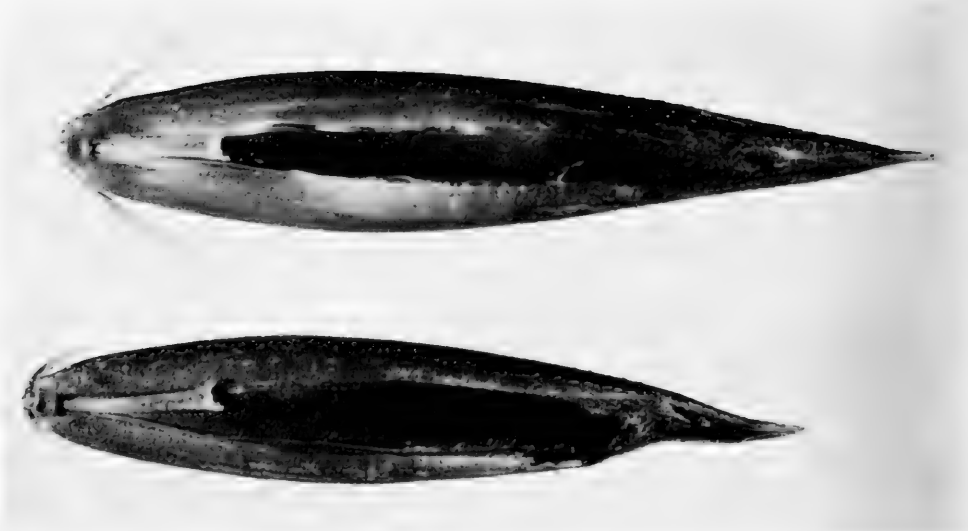
2. In oats the palea inferior of the kernel at the base of the spikelet—what we, following Atterberg, call the *aussenkorn*, or in English the outer-kernel—may bear a bristle and the basis of this kernel, the callus, may bear hairs. Some years ago I demonstrated[7] that the length of the hairs (see Fig. 13) and to a less extent the number of the hairs, are useful characters in the classification of the various varieties of oats. Pure lines of oats are not only characterized by a relatively constant length and number of these hairs but often by a relatively constant percentage of haired outer-kernels per plant.

Now the mean per cent per plant of outer-kernels bearing bristles or hairs is easily modified by external conditions. Never have I seen a variety of oats called bristled where every outer-kernel bore a bristle; nor have I ever seen a variety advertised as free from bristles where a bristle could not be found on one or more kernels. The same is true of the hairs on the basis. The characters "bristled" and "haired" can only be described by giving percentages per plant, the mean of a large number of plants of a variety or breed or line being determined.

Just because these two characters are so easily modified, I chose them for a test of selection in pure lines, making at the same time a test of another character: the per cent of 2-kerneled spikelets per plant, a so-called internal character. I determined to test these three characters not only in one and the same year, but also by taking the means for one line for a number of succeeding years, thereby measuring what Tower has called the place-variation. The method of selection which I employed is in part the same as that used by Hopkins and Smith in their classic selections of corn for high and low protein and oil content.[8] I

[7] Fruwirth: Fühling's landw. Zeitung, 56th yr., p. 298.

[8] Smith: *Ill. Agric. Exp. Station Bull.* 128; *American Breeders' Assn. Proc.*, Vol. vi (1910), p. 5.



CONTRASTED CHARACTERS IN AN OAT

At the left is a seed of the variety *Fichtel Mountain* with long hairs on the callus at its base; at the right is a short-haired specimen of the same variety. Dr. Fruwirth tried, by selecting the extreme long-haired seeds and the extreme short-haired seeds in each generation, planting them separately and self-fertilizing them, to change the proportions in which the two lengths were produced; but he failed. He therefore concludes that long-continued selection does not affect this character. Photomicrograph from the Imperial Station for Graphic Arts, Vienna. (Fig. 13.)

bred one part (branch) of a pure line of oats for selection to intensify the mean per cent of bristled outer-kernels, and similarly to augment the other characters; I bred another part (branch) of the *same* pure line for selection in the reverse direction. It was not practicable to bag the flowers, but the rarity of cross-pollination in oats, and the failure to observe any effects of cross-pollination in any character in any generation of the experiment, warrant me in considering my trials to represent pure lines. The variety used is that called Fichtel Mountain Oat. The mean (M) and the standard deviation (σ) used in the trials and given in the accompanying tables, are determined in the way outlined by Davenport,[9] the same methods having been used by Johannsen, who has made them well known in Europe.[10] I have further followed Johannsen's example in using the mean error of the mean (Mm) and mean error of the standard deviation ($M\sigma$) instead of the probable error used by Davenport (probable error = mean error $\times$ 0.6745).

The results of selection on the bristled outer-kernel are given in full in Table I.

CHANGES NOT HEREDITARY

Of course, one may well think that he sees in my table an effect of selection. The mean in the first generation, a generation not selected, is 5.11%; the mean after eight minus-selections is 2.65, after eight plus-selections is 3.14. But I reckon such an effect as not a hereditary effect. A change in the hereditary factors, if one were produced through selection, ought to augment from year to year if the selection is continued; at least, it should not drop back. As in Hopkins and Smith's trials with open-fertilized corn, the numbers of

[9] *Ill. Agric. Exp. Sta. Bull.* 119, 1907.

[10] Elemente der exakten Erblichkeitslehre, 2d ed., 1913.

the plus-series and minus-series should deviate more and more from each other. When in my experiments, therefore, one generation sometimes shows a higher per cent of bristles in the plus-series and a lower per cent in the minus-series than the previous generation showed, I think I am justified in calling this a non-inherited character of the parent, and by no means an indication of any change in the inherited factors. Similar effects have been observed in the trials with the Puy lentil and with white mustard, an increase in coloring of seeds being gained in one generation but not augmented in the next. I have called such an effect übertragung—transmission.

Similar effects have been observed with oats in the selection to augment or diminish the per cent of hairs per plant.

3. An internal or performance-character has also been studied in the same manner in oats: the character being the per cent production of one-kernelled or two-kernelled spikelets per plant. I have measured this character in terms of the per cent of two-kernelled spikelets. The results are given in the accompanying Table II.

The remarks to be made regarding this table are substantially the same as with the preceding one.

Just as I was closing my experiments and publishing their results in full, with remarks on several other subjects, in the Zeitschrift für Pflanzenzüchtung[11] (1915), Kiessling at Weihenstephan reported on his trials with two-rowed

TABLE I.—*Line No. 9; Per Cent of Bristling*

Year		− Selection	+ Selection
1906	Plant with which started.		
1907	Seeding:	Practically no bristles.	
	Harvest:	M 5.11 Mm ±0.68	
		σ 1.68 Mσ ±0.48	
		range 2.5−7.3	
1908	Seeding:	2.5	4.8
	Harvest:	M 5.47 Mm ±1.37	M 4.05 Mm ±0.88
		σ 4.32 Mσ ±0.97	σ 2.78 Mσ ±0.62
		range 0.0; 1.1−11.9	range 0.8−9.4
1909	Seeding:	0.0	9.2
	Harvest:	M 4.70 Mm ±1.03	M 4.75 Mm ±0.99
		σ 3.24 Mσ ±0.72	σ 3.12 Mσ ±0.69
		range 0.67−10.09	range 0.0; 0.6−10
1910	Seeding:	0.67	10
	Harvest:	M 2.94 Mm ±2.36	M 8.46 Mm ±1.61
		σ 11.80 Mσ ±1.66	σ 8.06 Mσ ±1.14
		range 0.0; 1.0−18.7	range 0.0; 2.0−21.9
1911	Seeding:	0.0	21.9
	Harvest:	M 0.14 Mm ±0.07	M 8.88 Mm ±1.47
		σ 0.33 Mσ ±0.05	σ 5.50 Mσ ±1.04
		range 0.0; 0.7−1	range 1.8—18.7
1912	Seeding:	0.0	18.7
	Harvest:	M 0.93 Mm ±0.22	M 1.02 Mm ±0.35
		σ 0.85 Mσ ±0.12	σ 1.65 Mσ ±0.25
		range 0.0; 0.4−0.5	range 0.0; 7.0−5.1
1913	Seeding:	0.0	5.1
	Harvest:	M 1.20 Mm ±0.33	M 3.58 Mm ±0.98
		σ 1.67 Mσ ±0.24	σ 4.18 Mσ ±0.69
		range 0.0; 0.5−5.9	range 0.0; 1.7−13
1914	Seeding:	0.0	13.0
	Harvest:	M 0.04 Mm ±0.09	M 0.64 Mm ±0.25
		σ 0.44 Mσ ±0.06	σ 1.25 Mσ ±0.17
		range 0.0−1.0	range 0.0; 1.0−5.7
1915	Seeding:	0.0	5.7
	Harvest:	M 2.65 Mm ±0.46	M 3.14 Mm ±0.55
		σ 2.32 Mσ ±0.33	σ 2.74 Mσ ±0.39
		range 0.0; 1.2−6.9	range 0.0; 1.3−10.5

[11] Zeitschrift für Pflanzenzüchtung, 1915, Heft 2.

TABLE II.—*Line No. 23; Per Cent of Spikelets with Two Kernels*

			− Selection				+ Selection		
1907	Seeding:		64.7						
	Harvest:	M	56.92	Mm	±2.68				
		σ	9.66	Mσ	±1.89				
			range 42.2−77.4						
1908	Seeding:		48.2						
	Harvest:	M	35.41	Mm	±3.33				
		σ	10.51	Mσ	±2.33				
			range 23.2−62.5						
1909	Seeding:		34.2						
	Harvest:	M	72.95	Mm	±3.29				
		σ	10.42	Mσ	±2.33				
			range 56.5−87.9						
1910	Seeding:		56.5				87.9		
	Harvest:	M	57.28	Mm	±2.71	M	59.06	Mm	±2.36
		σ	13.57	Mσ	±1.09	σ	11.82	Mσ	±1.66
			range 31.3−82.7				range 41.7−83.3		
1911	Seeding:		48.2				82.5		
	Harvest:	M	35.96	Mm	±4.39	M	41.45	Mm	±4.61
		σ	21.93	Mσ	±3.10	σ	23.06	Mσ	±3.24
			range 7.5−85.7				range 6.2−91.0		
1912	Seeding:		7.5				91.0		
	Harvest:	M	29.46	Mm	±2.19	M	34.46	Mm	±2.29
		σ	10.94	Mσ	±1.55	σ	11.43	Mσ	±1.62
			range 11.2−57				range 13.5−56.1		
1913	Seeding:		11.2				56.1		
	Harvest:	M	23.52	Mm	±1.70	M	22.07	Mm	±2.54
		σ	8.51	Mσ	±1.20	σ	13.72	Mσ	±1.94
			range 8.5−51				range 9.7−70.1		
1914	Seeding:		8.5				70.1		
	Harvest:	M	16.34	Mm	±3.39	M	22.89	Mm	±3.64
		σ	16.97	Mσ	±2.40	σ	18.22	Mσ	±2.58
			range 0.0; 1.2−72.9				range 0.0; 0.6−73.5		
1915	Seeding:		1.2				73.5		
	Harvest:	M	54.40	Mm	±4.05	M	40.03	Mm	±2.88
		σ	20.25	Mσ	±2.86	σ	14.44	Mσ	±2.04
			range 19.4−84.2				range 21.1−80.1		

barley. As in my recent trials with oats and my earlier trials with peas, a performance-character or internal character was chosen, viz., the protein content of the kernel, a character that is quantitatively modifiable to a very high degree. Five generations of pure-line selection to increase or diminish this character failed to produce any change. Some transmission, in the sense in which I have just defined it—what is also called nachwirkung—after-effect—has been found but no real modification of an inherited factor.

Critical scientists may, perhaps, object that if these various experiments had been continued much longer, some hereditary effects would be produced. In such a case, I admit that changes could occur; but I am of the opinion that they would not be the effects of selection. They would be mere spontaneous variations (mutations) whose production would be wholly independent of the selection; but whose preservation would naturally be result of selection.

Comparing these experiments with the results of Hopkins and Smith, I think the practical breeder may conclude that there is a marked difference between selecting in a self-pollinated plant and selecting in a cross-pollinated plant. In the selection with corn—a plant exceedingly subject to cross-fertilization—there is a marked hereditary effect. There is no hereditary effect in a self-fertile plant, such as I have used—save for a little transmission of immediate parental influence, which is not hereditary and cannot be made the basis for a change in the character of the pure line.

Is Cancer Inheritable?

That cancer is not inherited in man is the conclusion of the actuary Arthur Hunter, after an investigation of the family histories of life insurance policy holders. In cases where both of a man's parents died of cancer, only two grandparents, out of 234 known, died of cancer. He also investigated 314 sons and daughters of parents, both of whom had died of cancer, and found no cancer whatever among them. Only those were considered who had died above age 40, or were living above that age. Records were obtainable of 301 brothers and sisters of these cancerous pairs, and only nine cases of the affection were found among them. There were 488 families where one parent had died of cancer; of the 810 sons and daughters above age 40, only three were known to have had cancer. Other evidence from various sources is presented to the same effect. Mr. Hunter admits, however, that it may be found that some families or races are susceptible and others not, as experimental studies have shown to be the case with mice and rats. He presents evidence to indicate that cancer is not contagious. The facts were given in an address before the Association of Life Insurance Presidents, New York, December 16.

Remarkable Motion Pictures Shown

"How Life Begins," a five-reel motion picture, produced by George E. Stone at the University of California, was exhibited before a special meeting of the Washington members of the American Genetic Association on the evening of January 10. Dr. Alexander Graham Bell gave the use of his home for the occasion, and about 130 persons were present. The film, which was designed primarily for sex education, shows the process of fertilization and reproduction in the pea, butterfly, frog, sea-urchin, fowl and rat, as well as the process of reproduction by simple fission in Paramecium and by budding in yeast. The processes are explained by excellent diagrams and the details are shown accurately, yet with great delicacy and imagination. This film (which is controlled by the Exhibitors' Booking Agency, 220 West Forty-second Street, New York City) will not be commercialized, but is to be kept for educational work and a number of colleges and schools have already secured copies of it. It marks a great advance in the teaching of elementary biology.

Care of the Feebleminded in Germany

Germany is too slow in making provision for its feebleminded children, according to Herr Strakerjahn, who writes in the *Zt. f. d. Behandlung Schwachsinniger* (xxxiv, No. 1.) At present the number of those in special institutions is 30,000, while another 40,000 are in special schools. He advocates a campaign for the segregation or sterilization of those likely to become parents of feebleminded children.

It appears that Germany is at least ahead of the United States, if the above figures are correct, for the number of feebleminded receiving institutional care in this country is not much above 30,000, although the pouplation of the United States is half again as great as that of Germany. It is of course not possible to say whether the proportion of feebleminded in the total population is the same in the two countries, as the figures for both are unknown.

A POLYDACTYLOUS FAMILY

Edith S. Atwood and Clara P. Pond.

"IT'S pretty hard to find shoes to fit him," admitted the father of the 4-year-old boy shown in the frontispiece of this issue. His extra great toe projects so far from the normal line of the foot that the shoe usually hurts him. But the father is reconciled to this slight inconvenience, for he is tremendously proud of the polydactyl tendency of his offspring. Ought he not to feel triumphant, when there are still "shows" which will pay money to obtain abnormalities of this sort for exhibition?

There was a little girl in the family, now dead, who had one extra thumb. The next child, a boy, now about 2 years old, had one little supernumerary projecting from his right thumb. It has been recently removed. The baby, born in 1916, also a boy, has an extra thumb on each hand, and an extra great toe on each foot, exactly like the 4-year-old boy.

The father has two left thumbs, and double great toes on both feet. The extra thumb, he contends, is a convenience, since in manual work, if he hurts one thumb, he can close the other about his tools.

The father has a sister who has no extra digits, but has an extra joint in both thumbs, the left one being ankylosed. The double joint on the right hand she can bend down and in, thus being able to pull harder than an ordinary person. She has one daughter who is normal.

Another sister of the father had a rudimentary thumb removed from her right hand, at the first joint. In her left thumb the bones from the lower joint are double, but separate. She has single toes. She has two sons and two daughters, normal, with normal children, and another son whose second and third right fingers are webbed. A fleshy growth was recently removed from the second joint of one finger of his right hand, on account of the danger of its being caught in machinery.

Two brothers and one sister of the father were normal and have normal children.

The remaining brother, according to the informant, had extra great toes on both feet. The traits of his children are unknown.

The father's father had normal toes and a normal right thumb, but his left thumb was double jointed. There is no history of any abnormality of digits in the family of the father's mother.

The mother of the boy photographed has normal fingers and toes, as have all her immediate family, and all relatives so far as they know.

The Elementary Biology of Sex

THE WAY LIFE BEGINS, an Introduction to Sex Education, by Bertha Chapman Cady and Vernon Mosher Cady, with foreword by William Freeman Snow, M.D. Pp. 78. with 10 text figures and 9 colored plates. New York, American Social Hygiene Association, 105 West Fortieth Street, 1916. Price, $1.00.

Parents and teachers who desire to instruct children in the biology of reproduction are often ill instructed on the subject themselves, and find it difficult to get just the information they need. The above book should meet this need satisfactorily. It discusses frankly but delicately the subject of reproduction in the lily, moth, fish, frog, fowl, rabbit and man, and devotes attention to the general function of sex in evolution. The treatment is elementary but full and clear, and free from the sentimentality which disfigures many works on the subject. The book is heartily recommended.

The

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(Formerly the American Breeders' Magazine)

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CONTENTS

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CHICK WITH FOUR LEGS AND FOUR WINGS

The Single Comb Ancona chick above photographed was sent in by A. J. Pigott of Sulphide, Ont. While this type of meristic variation is not unusual, the equal development of the limbs is noteworthy, as in many instances the extra limbs tend to be only rudimentary. One can hardly doubt that this bird was produced from a single germ-cell. The head is the first part of the embryo to be formed. At about the time the head was formed, the hinder part of the embryo must have split. Experimental work gives color to the idea that this splitting is due to some chemical change. At the time the split occurred, the cells of the posterior part were evidently not much differentiated, and each half of the rear end of the embryo, therefore, went ahead in the customary way and produced a whole chick. This well illustrates the perfection of the developmental mechanism, which will function perfectly to the end even if reduced to half the usual quantity. The photograph at the right is not a frog, as might be supposed, but the same chick viewed by X-ray. (Frontispiece.) M. A. JULL, Macdonald College, Quebec.

THE "MELTING POT" A MYTH

Study of Members of Oldest American Families Shows that the Type is Still Very Diverse—No Amalgamation Going on to Produce a Strictly American Sub-Type—Characteristics of the Old American Stock

AMERICA as "The Melting Pot" of peoples is a picture often drawn by writers who do not trouble themselves as to the precision of their figures of speech.

Dr. Ales Hrdlicka has been investigating the older contents of this pot, and finds that even the material which went into it first has not yet so melted.[1]

Several hundred members of the old, white, American stock have been most carefully measured and examined in many ways, to find whether the people making up this stock are tending to become alike—whether a new sub-type of the human race is being formed here in America, with intermarriage, environment, and under the pressure of outward circumstances.

Dr. Hrdlicka finds very definitely that as yet such is not the case. The force of heredity is too strong to be radically altered in a century or two, and even the descendants of the Pilgrim Fathers, the Virginia cavaliers, the Pennsylvania Dutch and the Huguenots, while possibly not as much unlike as their ancestors probably were, are still far from a real blend.

"The Melting Pot" is a figure of speech; and, as far as physical anthropology is concerned, it will not be anything more in this country, at least for many centuries.

Dr. Hrdlicka, who is curator of the division of physical anthropology of the United States National Museum at Washington, has had this investigation under way for four years,[2] and it has been completed only within the last month—for Americans of unbroken American ancestry for even three generations are much scarcer than was supposed when the work was undertaken. Even the proud "Mayflower Descendant" is more likely than not, it would seem, to have at least one grandfather or grandmother who was born abroad. The conclusions here announced were reached a year ago, and must be regarded as not wholly final, yet doubtless reflecting the real conditions. With this understanding, some of the more remarkable of the preliminary results, based on the first 100 men and 100 women measured, may be cited.

GREAT RANGE OF VARIATION

"The most striking result of the examinations," Dr. Hrdlicka says, "is the great range of variation among Old Americans in nearly all the important measurements. The range of variation is such that in some of the most significant determinations it equals not only the variation of any one group, but the combined variations of all the groups that enter into the composition of the Americans." This fact would be interpreted by the geneticist as an evidence of hybridity. It is clear that, at the very beginning, a number of diverse, although not widely differing, stocks must have made up the colonial population; and intermarriage and the influence of the environment have not welded these stocks into one blend, but

[1] Some of the facts in this review were got from the oral communication of Dr. Hrdlicka to the XIX International Congress of Americanists, at Washington, December 28, 1915; others were given by Dr. Hrdlicka in conversation; much is taken verbatim from an advance copy of the paper to be published in the Proceedings of the Americanists at about the time the present review appears in print.

[2] See "Study of Old Americans," by Dr. Ales Hrdlicka, JOURNAL OF HEREDITY, Vol. VI, No. 11, p. 509 (November, 1914.

have merely produced a mosaic-like mixture. This is good evidence of the permanence of inherited traits, although it must be qualified by the statement that it does not extend equally to all the features of the body, the face, hands and feet having been found less variable than, for instance, the stature or form of the head.

Turning to the detailed measurements, this review can give only the averages: those who want to know the distribution of variations must consult Dr. Hrdlicka's own account, where they are all published.

STATURE

The stature of both American men and women is high, higher than the average of any European nation except the Scotch. The individual variation is, however, enormous, amounting to 16.4% of the average in males and nearly 16% in females. For males, 174 cm. is the average, for females 162. The arm spread in males is greater than their stature, in females it is less.

WEIGHT

The average weight of the males is 154 pounds, that of the females 130. Taking into consideration the tall stature, these weights are about equal to those among Europeans. The difference between male and females is 15.6%; among larger series of Europeans it is 17%, which indicates a slightly greater tendency to stoutness (among those above 30 years of age) among the American women than among their European sisters. Less than 10% of the men but at least 17% of the women were found to be decidedly under weight; the proportion of stout individuals was nearly the same in the two sexes.

BODY

The general proportions of the body must be classed as medium, but great fluctuations are shown, particularly in the chest—a feature which shows distinctly poor development among the women, often accompanied by deficient development of the breasts and shoulders. Indeed, one of the most striking of the facts brought out is that, barring individual exceptions, the women of the old American stock appear to be below par, physically. The males are, on the whole, admirable specimens of the white race; the females are not infrequently undersized, underdeveloped, and weak in comparison with what they should be.

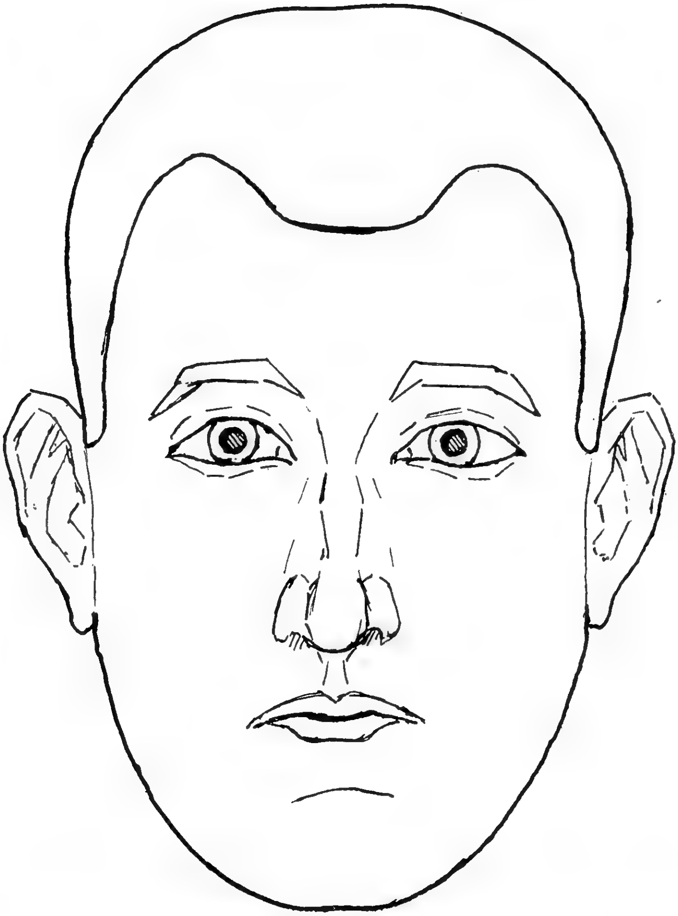
This difference is not due, the investigator thinks, to heredity, but is solely a matter of bringing-up. It is already being corrected in the younger generation, he thinks, for under the stimulus of widespread interest in sports, outdoor life and a sensible manner of living, not a few of the younger women and girls whom he has measured seem to be superior to their mothers. But he sees still room for improvement, if the women of the old American families are to be as a class such physically good types of womanhood as are the American men of manhood.

FACE

The face is, in general, high and oval; in females it occasionally gives the impression of narrowness. The forehead is well developed in both sexes, a fact which should please those persons who believe frontal development to be a sure sign of intellectual capacity. The nose is prevalently long and of medium breadth; it is longer than that in any immigrants coming to this country who have so far been measured,[3] except the English, in whom the proportions, as to both length and breadth, are practically identical with those of the Americans. The mouth shows medium breadth in both sexes, and its averages equal exactly those obtained for the French. The ears of the old Americans are longer than those of any immigrants except the English.

Comparing the present representatives of the old American stock with what is known of their ancestors, it appears that the face has retained its length but is

[3] Comprising Armenians, Croatians, English, Greeks, Russian Jews, Irish, South Italians, North Italians, Magyars, Poles, Rumanians and Russians, 500 individuals in all.



NOT THE MEANEST MAN, BUT A REALLY MEAN ONE

To anthropologists, the "mean man" of a race is an imaginary ideal, as a circle is to a geometer. Each of his features measures the mean or average of that feature in all the individuals of his race. He is in every respect an average man. The above diagram, drawn to scale from Hrdlicka's data by C. H. Popenoe, shows the mean man of the old white American stock. It is a highly specialized face which, according to ordinary ideas, is of a very superior type. The most conspicuous peculiarities of the type are the almost oblong outline of the face, and the high, well-developed forehead.

According to many anthropologists, the mean man is the standard of beauty of a people. Any feature—mouth or nose, for example—is admired in proportion as it approximates in its measurements the mean or average of that feature for the race. The face which is most admired is that which has the fewest exceptional peculiarities—which is in every respect the most mediocre, as a statistician would say. The idea of a mean man is therefore of much importance not only to students of anthropology, but to students of aesthetics. (Fig. 1.)

diminishing in breadth, and that the jaws are getting smaller.

PHYSIOLOGICAL OBSERVATIONS

The average body temperature, under the tongue and at rest, is 98.5° in the male and 98.7° in the female. Considerable variation is found, the absolutely normal limits probably being 97.5° to 99° in the male and 98° to 99.2° in the female.

The pulse averaged in males 70.6 beats per minute, in females 75.2 per minute. The normal range of variation in each sex was about 30 beats (15 below to 15 above the average).

The average rate of respiration found in males was 17.2, in females 18.5, with considerable individual variation in both sexes—males 11 to 22, females 10 to 24.

HAIR COLOR

One of the most interesting results is that there were obtained among these first 200 individuals studied no pronounced blonds, although the ancestry of these subjects is supposed to have been North European, where blondness is more or less prevalent.[4] More men than women are dark, and conversely, more women than men are light. It is a notable fact that not a single case of real red hair has been found among the males in this investigation, while 10% of the females boast some approach to Titian tresses. Also, there was not a single case of black hair, in either sex. The exact distribution is:

	Male	*Female*
Light-brown	12%	16%
Medium-brown to dark-brown	77%	68%
Very dark	11%	6%
Golden-reds and reds	00%	10%

EYE COLOR

The color of eyes in the two sexes is practically identical, blue eyes being found in about half the cases. Dr. Hrdlicka's classification is as follows:

	Male	*Female*
Gray	2%	4%
Greenish	7%	10%
Blues	54%	50%
Browns	37%	36%

HEAD FORM

The head among old Americans is, in many cases, notable for its good development, particularly in males. Among twelve groups of male immigrants measured at Ellis Island under Dr. Hrdlicka's direction in recent years, not one group quite equals in this respect the Americans, the nearest approach being noted in the Irish, Bohemians, English, Poles and North Italians. The type of head, however, differs among the Americans very widely, as is the case with most civilized races at the present day.

Head form is most conveniently described by means of the cephalic index, that is, the ratio of breadth to length. Anthropologists generally speak of anyone with an index of 75 (or where the breadth is 75% of the length) and below this, as dolichocephalic, or long-headed; from 75 to 80 is the class of the mesocephalic, intermediates; while above 80 is that of subbrachycephalic and brachycephalic or round-headed. For the most part, the old Americans fall into the intermediate class, the average index of males being 78.3 and that of females 79.5.

Barring a few French Huguenots, the old Americans considered here are mostly of British ancestry, and their head-form corresponds rather closely to that of the English of the present day. In England, as well known, the round-headed type of Central and Eastern Europe, the Alpine or Celto-Slav type, has few representatives. The population is composed principally

[4] See for example "The Passing of the Great Race," by Madison Grant (p. 74, New York, 1916): "One often hears the statement made that native Americans of Colonial ancestry are of mixed ethnic origin. This is not true. At the time of the Revolutionary War the settlers in the thirteen colonies were not only purely Nordic, but also purely Teutonic, a very large majority being Anglo-Saxon in the most limited meaning of that term. The New England settlers in particular came from those counties of England where the blood was almost purely Saxon, Anglian, and Dane."

A TYPICAL MEMBER OF THE OLD WHITE AMERICAN STOCK

Dr. Hrdlicka declares that the above head (belonging to Rev. H. E. Robbins, a Connecticut Yankee, now in Canaseraga, N. Y.), is one of the best examples he has seen of a common type of Old White American. The cheek bones are a little more prominent than usual; otherwise the features are almost average. In proportion of breadth to length the skull is neither long nor round, but intermediate; the forehead is high, nose and ears somewhat large, and jaw reduced. It is a highly specialized type, the large size of the skull in proportion to the size of the face indicating an advanced degree of evolution. But it can be matched by many English heads, for the Old White Americans are a somewhat heterogeneous stock, not racially distinct. (Fig. 2.)

of long-headed peoples, deriving from the two great European stocks, the Nordic and the Mediterranean. To the latter the frequency of dark hair and brown eyes is probably due, both in England and in America.

While the average of the old Americans corresponds closely to the average of the English, there is a great deal of variation in both countries. The cephalic index is a good trait for comparison, because it has been calculated so extensively by anthropologists. It will be worth while, therefore, to examine this trait more carefully, to learn whether the American stock seems to be changing.

Unfortunately, it is impossible to compare the present Americans with their ancestors, because measurements of the latter are lacking. But to assume that the early colonists did not differ greatly from the modern English is probably justifiable. A comparison of modern Americans (of the old white stock) with modern English should give basis for an opinion as to whether the English stock underwent any marked modifications, on coming to a new environment.

It has already been noted that the average cephalic index is practically the same; the only possibility of a change then lies in the amount of variability. Is the American stock more or less variable? Can a "melting pot" influence be seen, tending to produce homogeneity, or has change of environment rather produced greater variability, as is sometimes said to be the case?

The amount of variability is most conveniently measured by a coefficient known as the standard deviation (σ), which is small when the range of variation is small, but large when diversity of the material is great. The following comparisons of the point at issue may be made.[5]

	Avg.	σ
100 American men........	78.3	3.1
1011 Cambridge graduates (English males).......	79.58	2.95

For the men, little difference is discernible. The old Americans are slightly more long-headed than the English, but the amount of variation in this trait is nearly the same on the two sides of the ocean.

The average of the American women is 79.5 with $\sigma = 2.6$. No suitable series of measurements of English women has been found for comparison. It will be noted that the American women are slightly more round-headed than the men: this is found regularly to be the case, when comparisons of head-form of the two sexes are made in any race.

NO GEOGRAPHICAL TYPES

Dr. Hrdlicka's study has further given him opportunity to find whether there are any marked geographical types among the old Americans: whether, for instance, the first families of Virginia are measureably different from the Puritans of New England. He believes that they are not—that such differences as are recognized are merely those of training, habits, dress, and social customs; and that this, likewise, holds true of the westerners, whose more or less recognizable type Dr. Hrdlicka finds to be merely a matter of home influence, education and dress, and not so much of structure or physiology.

Two main objects were in view when the study of the old Americans was undertaken. One was to establish reliable norms or standards for anthropological comparisons.

The other main object in view was, as already said, to determine whether the descendants of the early American settlers, living in a new environment and more or less constantly intermarrying, were being amalgamated into a distinct sub-type of the white race. Enough has already been found, as this preliminary report shows, to prove that such amalgamation has not taken place to any important degree. The persistency in heredity of certain features,

[5] English data from K. Pearson, Biometrika V, p. 124. Thanks are due to Dr. Sewall Wright for calculating the standard deviations of Hrdlicka's data.

which run down even through six or eight generations, is one of the remarkable results brought out by the study.

If the process could continue for a few hundred years more, Dr. Hrdlicka thinks, it might reach a point where one could speak of the members of old American families as of a distinct stock. But so far this point has not been reached; the Americans are almost as diverse and variable, it appears, as were their first ancestors in this country.

Progress of Plant Breeding in Italy

Systematic plant-breeding, principally with cereals, is being carried on in ten different places in Italy, with satisfactory results. Most of the work is modeled on that of the Swedish station of Svalöf. Dr. G. Patanè, of the Italian Ministry of Agriculture, contributes a review of the work in the *International Review of the Science and Practice of Agriculture* (Rome, June, 1916), in which he enumerates the following stations:

1. Royal Experiment Station for Cereal Culture, Rieti, directed by N. Strampelli. Important work has been done with wheat during the past ten years; valuable strains have been isolated, and much hybridization done. Species and genus crosses have resulted in some novelties such as *Triticum giganteum*, a wheat the grains of which are almost equal in size to coffee beans. Barley, oats, maize, rye, pulses, potatoes, pumpkins, tomatoes, alfalfa, and other crops have been the object of work.

2. Bolognese Coöperative Society for the Production of Agricultural Seeds, directed by Prof. Todaro. It is furnishing varieties of wheat, maize and barley particularly adapted to local conditions.

3. Royal Agricultural Station, Modena, directed by G. Lo Priore. Most of its work is with wheat.

4. Royal Agricultural College, Milan. Prof. Ugo Brizi is studying cleistogamy and parthenogenesis from the standpoint of genetics, especially in the Cruciferae and Chenopodiaceæ. Cereals and Leguminosæ are being bred on Mendelian lines. Dr. P. Venino has been isolating pure lines of wheat.

5. Royal Agricultural Experiment Station, Perugia. The director, A. Vivenza, has been carrying on selection work since 1900, and for six years has been selecting in a strain which appears to be furnishing constantly small mutations, so that it can be modified by persistent selection.

6. Royal Botanical Garden, Palermo, Sicily. Director A. Borzì. Here Dr. Tropea has been trying to produce a variety of wheat resistant to seasonal changes, and also studying the coefficient of density, influence of origin of seeds on acclimatization, inheritance of acquired characters, etc.

7. Royal School of Practical Agriculture, Andria. Director L. Vivarelli is working with local varieties of wheat.

8. Vegni Agricultural Institute, Barullo, director D. Vigiani. Selection has been made of strains of wheat, oats, maize, beets, turnips, hemp, tobacco, and forage plants.

9. Agricultural Institute of Scandicci, Florence, founded and directed by Prof. Passerini. Selection of wheat.

10. Experiment Station for Rice Culture, Vercelli, director, N. Novelli. Pedigree culture of native and imported rice.

The Treatment of Criminals

Emphasizing the need for more biology in dealing with crime, Dr. Paul M. Bowers told the last meeting of the American Prison Association about his study of 100 recidivists, each of whom had been convicted not fewer than four times. Of these twelve were insane, twenty-three feebleminded, and ten epileptic, according to his findings, and in each case, he said, the mental defectiveness bore a direct causal relation to the crime committed. Other speakers agreed that those who have to deal with criminals should give more attention to the heredity and actual physical and mental condition of offenders; that they should study the natures of men, instead of only legal precedents.

SIGNIFICANT EVIDENCE FOR MENTAL HEREDITY

Much Supposed Proof Worthless—Problem Is One of Human Differences, and Must be Approached Objectively—Evidence from Twins, Royal Families, and Eminent Men—Difficulties to be Avoided[1]

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ANY discussion of the significant evidence for mental heredity must aim at unravelling the part taken by heredity as opposed to external forces of nature commonly called the environment, and also as opposed to a possible internal force, acting apart from the known laws of nature and commonly called free-will. This latter aspect is usually ignored in scientific discussions of the question; but it should not be ignored. As a matter of fact, for countless ages millions of people have been, and are today, firm believers in the existence of spiritual forces capable of overcoming the material world and directing molecular change. It is easy to see that if the doctrine of reincarnation is strictly true, so that souls pass from one body to another at haphazard, and if it makes no difference whose infantile body one happens to vitalize, then there can be no mental and moral resemblance between father and son, brother and brother, sister and sister, or decreasing family resemblances as the relationship becomes more remote. The physical resemblances would be there, but the supposed spiritual resemblances would be a sham. There is no scientific reason *a priori* why this should not be so. It would be just like us to deceive ourselves on a point like this. The transcendentalist, transmigrationist, idealist of whatever school, might well say, "You scientists see the facial resemblance and you imagine the rest. You pick out instances of mental similarity between father and son or between other relatives, but these are the exceptions. Of course, out of all the people of the community you can find some instances of spiritual resemblances. Living in the same mental and moral atmosphere would account for that." The idealists might say, "We ourselves believe in education and the value of a good example. The researches of the scientists amount to nothing—they prove nothing more than a general tendency of similar traits to be found in similar home and social life."

I regret to say that a very large portion of the published literature on mental heredity is open to this criticism and proves nothing at all as to the relative importance of heredity. Many text-books, magazine articles, readable books on eugenics, books on biology containing chapters on human heredity, are worse than the primary literature itself. Why this should be so I do not know, but I suppose that in the desire of the writer to make the book or article, first of all interesting on the human side, he takes any kind of evidence that happens to make a human appeal. It is essentially a human question, and that means that it is very difficult to get a disinterested discussion. This is not true of most departments of natural science. In chemistry, physics, geology, astronomy, it makes very little difference to human pride how the theories work out, but in the question of human heredity

[1] Read in New York City before the thirteenth annual meeting of the American Genetic Association, December 27, 1916.

everyone has something at stake. The tendency is to take every argument subjectively.

THE BIAS OF HOPE

People think of themselves and of their own families, ancestors and children. And then the question of hope comes in—the wish is father to the thought. The preacher, the educator, the reformer, the mother of children does not wish to give up any part of what is for him or her a natural hope and stimulus. Then again, all people of mature years have necessarily, by force of contact with the world, some ideas about human nature and the reasons for human conduct. Very few persons have anything at stake on the nebular theory of the cosmos or the electron theory of matter. These theories can be worked out and settled without opposition from the public. But how great was the storm over the Darwinian *Descent of Man!*

If we wish to know the truth, we must cleave to truth-seeking methods, and this means the objective methods of science. In all departments of science nothing is of more importance than the taking of accurate measurements, and, if we stop to think of it, nearly all our measurements are measurements of differences. The stars are in one place one night and in a different place the next; a description of the chemical elements is a description of their measured differences. So the problem of heredity should be one of measured differences. No inductive science is absolutely accurate, but all are striving towards an increased accuracy, an ideal of perfection which loses nothing of its beauty in the impossibility of its attainment.

The first to apply scientific measurements in a large way to human heredity was, as is well known, Francis Galton. All the discussion of the inherent nature of man in all the ages, from the Greeks to the medieval churchmen, from the confused philosphers of the period of Rousseau, even down to the transcendentalists of almost our own time, was not worth as much as the work of this one man, incomplete and fragmentary as it necessarily was. Curiously enough the year 1865, in which Galton first published, was also the year in which the now celebrated Mendel first gave his results to the world. Neither of these men was aware of the existence of the other, much less could have imagined the, to a considerable extent, needless and, at times, bitter controversy that was to arise among such of their followers as were unable to grasp the whole subject and see wherein both methods could be harmonized and accepted as leading towards one great truth. Whatever one may think of the relative value of the methods of Galton and the methods of Mendel as regards inheritance among plants and animals, there can be no question that, so far as human psychological inheritance is concerned, the work of Galton and the methods founded and developed by Galton and Pearson are of vastly more importance, at least as regards work already done.

HUMAN PROBLEM DISTINCT

It is no use to say that the same laws must apply to plants and animals as apply to man. Only in the most generalized sense is that true and then, perhaps, only for certain laws and not for others. As far as heredity and environment are concerned, our own problem contains right on the face of it something that makes it very certain that the same laws cannot apply. It is inconceivable that environment should act just as much on one individual as on another, that all creatures should be equally at the mercy of their various environments, that some cannot escape from or choose their environments better than others. Certainly the human brain is either more affected by its environment than the brain of a worm or boll of a cotton plant, or else it is less affected. Since our major problem, significant evidence of mental heredity, needs just that unravelling of the heredity-environment complex, our very first problem is to find out if the brains of men, the brains of average men, of great men, of children, of women, of eminent women, of different classes of men, of different races, separately not collectively, are more or less

affected by their environment than the brains of dogs and cats, of worms and mollusks. Not only in the heredity-environment complex are there sure to be great differences between higher and lower types in their reactions to their surroundings, but if we have also the problem of free-will to deal with—and we certainly do have it to deal with and perhaps it will be one of the last and most scientific problems of all—then, it is not presumptuous to suppose that free-will acts somewhat more in a man than it does in a tree. At any rate, if there is any such thing demonstrable, there will be differences and these differences will be measurable.

A PROBLEM OF DIFFERENCES

And this brings us back to the crux of the whole question. The heredity-environment tangle can never be unravelled until it is made into a problem of differences and as far as mental and moral heredity is concerned, there have been very few pieces of evidence found that can be called significant in this respect. But these few are very significant up to a point, as I shall show later.

To explain the method of differences it is best to take a single example. A factory manager wishes to test an "efficiency scheme." He keeps all the conditions as nearly as possible the same, introduces his novel method, and if a notable result follows he is justified in ascribing it to the new scheme, or at least he has a probability in his favor, and if he experimented long enough he might approach practical certainty. Such an experiment would not solve the heredity-environment problem, but it would be a very real contribution, though a very minor one. What it would show would be just what influence one particular change in the environment would be likely to have on one particular type or class of men. There would be every reason to suppose that in other manufacturing plants, with about the same sort of workmen, about the same sort of result would be obtained.

All this throws no light on heredity in worms and fishes, but for man it does throw clear light as far as it goes; it gives a valuable and definite answer. It is of a type that I believe researches must be if they are best to contribute to the solution of the heredity-environment problem. One of the two factors must be kept virtually stable or unchanging during the experiment, while the other is observed to change. Many experiments along such lines are being performed all the time at agricultural stations; for example, the soil is fertilized in several little adjacent plots with different sorts of fertilizer, the seed being always samples from the same lot; the measured differences in the results represent the practical value of the differences in the fertilizers. In the same way if the soil, moisture, sunshine and all the conditions that affect growth be kept as constant as possible, the monetary value of different seeds, of different ancestral strains and crossings can be gradually determined. Thus an essentially practical science of the subject is built up, each experimenter adding something, provided his experiment has been properly conducted.

WRONG STATEMENT OF CASE

It is a waste of time to argue whether for any one individual, heredity or environment is more important. Each is, in a sense, entirely important. *Some* changes in the environment are more important than others, some even leading to death of the organism. *Some* changes in the germ are more important than others, as they lead to trivial or fundamental alterations of adult structure, but there is no way that I know of to make the consideration of them anything more than a verbal quibble except to specify definite particular traits, which for some reason or other seem interesting or significant, and then to measure those traits by what I have spoken of as the method of differences.

It is not easy to get good material for psychological inheritance which can be dealt with in this way. Generally when the heredity is different, as for instance among the various social classes, wealth, education and all the

other "atmospheric" conditions are also different. We cannot experiment *ad libitum*, as the agriculturist does, but there are already certain curious collections of data either discovered or compiled which give us a chance to test the same heredity under shifting circumstances, or the effect of a varying germ-plasm developing under uniform conditions. One of the first instances to be utilized and one of the most interesting is the evidence from various sorts of twins. It is known that there are two sorts of twins. The true or "identical" twins are developed from a single original cell which at some very early stage divided to form two individual beings. These "identical" or "duplicate" twins have a nearly (though never an absolutely) identical germ-plasm or heredity. Ordinary brothers and sisters are not nearly as identical in their origin. They spring from cells necessarily somewhat similar though not nearly so much so. Fortunately for our knowledge of heredity it often happens that brothers and sisters are born at the same time, who are also called twins, but are in a different category from the true or identical twins. These are on the same basis for hereditary resemblance as ordinary brothers and sisters, and are known as "fraternal" twins. As far as we can see, home environment for the "identical" twins is no more identical than for the "fraternal" twins. In both cases there are slight differences which tend to become greater from the start, but not more in one than the other. If they are of the same sex the parents commonly do not know which variety they are. As the twins grow up they may remain very much alike in mental characteristics or they may diverge as much as ordinary brothers and sisters.

THE TWO KINDS OF TWINS

Thorndike[2] presents some evidence to discredit the commonly accepted view that there are absolutely two kinds of human twins or, rather, that any considerable percentage of twins develop from one fertilized egg. He finds all degrees of gradation in his measurements of New York school children, but I am inclined to think that there are two kinds of twins from the embryologist's point of view, in spite of the gradation in measurements. We know that there are in the widest extreme two kinds. Those of different sex must come from two distinct ova, each fertilized by a separate sperm. Our present knowledge of sex causation, and of the accessory chromosome, makes it almost certain that those of opposite sex are from two ova and two spermatazoa. If this is true for opposite sexes, why not for the same sex? There should be as many more of the same sort who happen to be of the same sex, boy and boy, or girl and girl. We also know from embryological evidence that it is possible to have two persons derived from the single fertilized ovum. No one denies this. Therefore, what seems to me most likely to explain all the facts is that in the case of identical twins, if the single cell splits early and uniformly into two almost identical parts, we get the closest approximation to identity. If the division takes place in the four or eight cell stage or later, or if for any reason the chromosomes are not so evenly divided, even if the separation took place in the one cell stage, then the adult resemblance would be less strong.

The fact that there is lack of agreement on this point does not make the evidence from twins without significance for mental heredity, but it does call into question whether we can be sure that we are dealing with a very much more identical germ-plasm in one class of cases than in another. Therefore we cannot very well apply all of the tests of "heredity the same," "environment changed" that I advocated in what I call the method of differences.

Some comparison of this sort can, however, be made. For instance, twins between 9 and 14 years of age were tested in two ways: first, in their ability to add and multiply figures.

[2] Measurements of Twins, Archives of Philosophy, Psychology and Scientific Methods, No. 1, New York, 1905.

This sort of work is very susceptible of improvement through training, but they were virtually just as much like each other in the second test, *i.e.*, their ability to do puzzles which they had never seen before. This is just what we should expect if inborn causes were back of the great mental similarity of twins; but it does not prove that heredity and environment working together may not have caused the striking resemblance. It does not separate heredity from environment except on the specific point of training in arithmetic. It shows a failure of environment to make itself manifest.

Again, older twins and younger twins were compared. There were two groups—one 9 to 11, and one 12 to 14 years of age. The older twins showed no closer resemblance than the younger. The twins would, through the inherent tendency to diversification, tend a little towards dissimilarity merely through the three years of aging. They do, as a matter of fact, become a little less similar during the three years.

This shows that there was nothing in the identity of the home and school life at that time to mold them to one type.

THE MIND AND THE BODY

Although we cannot much separate heredity and environment specifically by the use of present day data concerning twins, they yet furnish a great deal of evidence that is significant for mental heredity. The fact is significant that all the measurements show the similarities to be on the average as strong for the mental as for the physical. The fact that they are, for instance, just as much alike in their ability to solve new puzzles as they are in the color of their eyes is very significant, since eye-color differences are known through Mendelian experiments to be foreshadowed by differences in the germ-plasm.

For actual measurements of the effect of a changing environment we must keep the heredity factor constant or virtually so. In the efficiency experts' experiment this requirement was sufficiently fulfilled. In the case cited of the seed and the fertilizers, we are satisfied that we get a large enough degree of identity in the seed by taking a large enough number of seeds for samples. In the same way human environment values could be tested by using a large enough number of cases to insure equality of germ-plasm in two groups under differing imposed environments. The careers of younger sons and of older sons in the British nobility and gentry ought to furnish material. All the sons ought to average about the same heredity, whether they are younger or older. There is a good deal of dispute on the question of the first born being different from the others. The first born appears to be more able, and also, curiously enough, more unable. If he is more apt to be a college professor he is also more apt to be a criminal or a high-grade imbecile. All this may be a statistical fallacy or due to something surrounding the conditions of the birth of a first born, survival values, etc. The point, so far as it concerns us, is that it has to be taken into consideration. But let us suppose that we found very different mental characteristics between second sons and third sons: I would say that this might be a good example of the power of environment to modify traits.

EFFECT OF SELECTION

Some of it would be due to characters naturally fitting into their careers of the army, the law or the church, but some of the differences, if found, would probably be due to the power of a convention or habit of society to produce mental and moral differences. We should have to follow out the careers and know to what extent men actually selected or stuck to congenial occupations. If the church is only made up of those men who find the life congenial to their natures, then, of course, this group of sons will have different traits from those who stick to the army. The whole question is—and this must always be thought of—is there a constraint imposed or is there not? In most of the experiments on animals a very severe restraint on freedom of choice is imposed.

I was able to make one experimental

or statistical test of the effect of a peculiar social restraint or law on a certain class of persons, in data which I had collected for inheritance in the royal families of Europe. Some members of the family reach the throne and become sovereign rulers, while others do not. Here, then, are two distinctly different psychological environments acting on the same heredity, or more strictly speaking, virtually the same average heredity which we secure on the same principle as the agricultural experimenter who takes two handfuls of seed from the same bin. I think everyone would have supposed that a part, at least, of the intellectual eminence of Frederick the Great, Peter the Great, or Gustavus Adolphus was due to the fortunate opportunity of an exalted official position. Perhaps this is true; I cannot say that it is not true; but if it is true to any considerable extent, why does it not show itself between sovereigns and their younger brothers? Here is a definitely measurable difference of environment, which, as far as I have been able to see, has no particular effect one way or another.

The eminence of the younger sons is just as great as that of the actual rulers. In 403 cases[3] it does not show itself to any significant degree. All this sets us thinking. It does not disprove that exceptional opportunity has favored the sovereign, for it may be that opportunities of kingship have favored him and other opportunities just as beneficial have favored the younger sons. All it shows is that a certain specific difference in opportunity has been unable to make itself felt. Therefore, it is not right to say that kings are favored by their peculiar opportunity of kingship.

GREAT MEN AND THEIR KIN

Another instance of failure of opportunity to produce a measurable difference is obtained from a comparison of the great men of America with the great men of Europe. The proportionate number of great men in European history who are related to other eminent persons is well known from the investigations of Galton, de Candolle and Ellis. The proportion for men of the highest type is about one in two. That is, one out of every two has an eminent blood relation as close as great-grandparent or great-grandson. This is far greater than the average expectation, but it does not prove anything against the influence of nurture since these very men necessarily, more than common men, were brought up in exceptional environments. My own investigations into the family history of great men in the United States show that the ratios are not different in this country. This fact does not prove that the Americans have not also been benefitted by the traditions and educational advantages of belonging to good families, but it does prove that supposed superior opportunities in the newer country have not produced an easily measurable difference.

Where, then, can environment be expected to be found working at its maximum or surely making itself felt to some measurable extent? Certainly environment has some influence. The present war teaches us that, for the same men in Europe are very different men in outward action and inward thought from what they were in June, 1914. It is also highly probable to my mind that not only great national crises, but also slowly developing national forces, when under the firm and constant leadership of some very great man or collection of men, profoundly alter for a time the thoughts and activities of large numbers of men.

On the other hand, the significant evidence for mental heredity is very considerable. The correlation ratios for mental and physical traits, the facts of alternative mental heredity, all have their significance and value, even if they do not separate internal from external forces. The justification for all this is too long a story to enter into here, and I have not attempted in this paper to enumerate the results. My aim has been, rather, to point out a method of procedure for future re-

[3] *Science*, June 19, 1914.

searches and to show the distinction between measuring heredity with environment, both inextricably working together, and measuring either of these forces apart from the other, which latter class of researches, I believe, will more and more build up a true practical science of eugenics.

Race Hygiene in Germany

Widespread interest is aroused by the war for all questions relating to eugenics and race hygiene. The aim is chiefly positive, *i. e.*, directed towards the higher propagation of the fit. A large number of valuable pamphlets have appeared on the market and several new societies have been founded. Besides the "Deutsche Gesellschaft für Rassenhygiene (München)," with several locals in the empire, there exists now a well organized "Deutsche Gesellschaft für Bevölkerungspolitik" with headquarters in Berlin, which mainly wants to check the declining birth rate. In Halle the "Gesellschaft für die Erhaltung und Mehrung der deutschen Volkskraft," in Düsseldorf, the "Gesellschaft für Familienwohl" and in Frankfurt the "Rhein-Mainische Gesellschaft für Bevölkerungspolitik" follow the same course. A central organization of many societies of different character (labor unions, women's organizations, Christian clubs, etc.) but all interested in race hygiene was called into life, the affairs being carried on temporarily by the "Deutscher Sittlichkeitsverein" in Berlin-Plötzensee. This central organ largely represents societies which see in race hygiene and eugenics a moral question. Great masses of the average population stand behind the societies affiliated. One of the consequences of the war is that more stress is being laid upon the moral side of the question and the greatest enemy of positive eugenics is seen in the egoism and luxury of modern life which destroy the family and check the birth rate.

Of negative eugenics the question is much debated whether and how the marriage of people afflicted with venereal diseases should be checked. No haphazard legislation is wanted. For instance the *Arzteverein* in München discussed this question about a year ago, but without reaching a conclusion. The best solution seems to be that all veneral diseases be made declarable, that every person afflicted with such a disease be obliged to cure himself, that the contamination of another person with venereal disease be made a crime and that people declared to be afflicted with a contagious venereal disease be prohibited from marriage. The German conception of race hygiene, as is seen also in this case, embraces more than the American idea of pure eugenics, as it is thought that eugenics and other phases of social life are linked together in a way which demands a common consideration of all our social institutions from the viewpoint of the benefit of future generations.

G. von Hoffmann, Berlin.

The Microscope in Zoölogy

ANIMAL MICROLOGY. Practical exercises in zoölogical microtechnique, by Michael F. Guyer, Professor of Zoölogy in the University of Wisconsin. With a chapter on drawing by Elizabeth H. Smith, Instructor in Zoölogy in the University of Wisconsin. Pp. 290, with 74 figures. Revised edition, price $2 net, postage extra. Weight 1 lb. 10 oz. Chicago, the University of Chicago Press, 1917.

Dr. Guyer's handbook has now been in use for ten years and is generally recognized as one of the most practical and satisfactory works on microscopic technique which has been written. It is intended primarily for the beginner, but will be found useful by anyone who does microscopical work. This new edition contains descriptions of many new methods, and a chapter on cytology which gives full directions for study of chromosomes. Geneticists are coming more and more to realize that their breeding work should be checked up by the use of the microscope, and Dr. Guyer's book should be of much value to them.

POLAR BEAR CACTI

Analogies between Polar Bears and Shaggy-Haired Cacti of the High Andes of Peru As Examples of Adaptation to Special Conditions of Existence

O. F. Cook
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and Alice Carter Cook

THE polar bear represents one of the traditional examples of adaptation to special conditions of existence. It is easy to understand that a dark colored bear or a short haired bear would be at a great disadvantage among the arctic snow fields. The polar bear differs from all his kindred in these two features that are necessary to make him a success in his own peculiar environment.

It seems clear in such cases that there is a real relation between the special characters and the special environment, and many writers have believed that the relation was one of cause and effect, that in some way or other the environment itself had produced the appropriate characters. Many, indeed, have gone further and urged that all characters must have environmental importance, and hence that the environment must be the underlying cause of the evolutionary progress of species. Nevertheless, nobody has explained how the external conditions are able to bring about evolutionary changes in species. Environmental causes of evolution have not been found, in spite of a century of search by Lamarck and Darwin, and their numerous followers. The relation between evolution and environment is still to be considered as an open question, in view of the widely divergent opinions that continue to be expressed by writers on the subject.

Adaptation may be defined as the possession of characters of environmental fitness. In a sufficiently general sense all characters may be considered as adaptive, for if any were definitely nonadaptive they would interfere with the existence of the species. Nevertheless, some characters are much more obviously adaptive than others, as in this case of the polar bear, the only member of its group that is able to live in its special environment by virtue of peculiar characters, the lack of which appears to exclude other species.

A CACTUS OF THE ANDES

In the Southern Hemisphere is another example of adaptation which may be compared to this of the polar bear. Many exposed slopes on the bleak plateaus of the high Andes are dotted with clumps of pure white cacti that look from a distance like small masses of snow. On closer view, the shaggy white hair of these cacti makes them appear like small sheep or poodle-dogs, or like reduced caricatures of the denizens of the arctic regions. We are so accustomed to think of cacti primarily as desert plants, peculiarly adapted to hot, dry deserts, that they seem distinctly out of place on the cold plateaus of the high Andes of southern Peru.

Some long-haired or canescent cacti are found in lowland deserts. Hair several inches long covers the young plants and the growing parts of older ones so suggestively that they are popularly known as "old men" or "old women." These hairy desert forms, however, do not seem to enjoy any important advantage over their unprotected, naked relatives that are just as common in these same localities. But in the high Andes there is a species so entirely covered with long white hairs that it may appropriately be called the Polar Bear Cactus. In some localities it is very abundant, dotting the grassy slopes like flocks of diminutive sheep

CLUMP OF POLAR BEAR CACTI AT ELEVATION OF 14,000 FEET

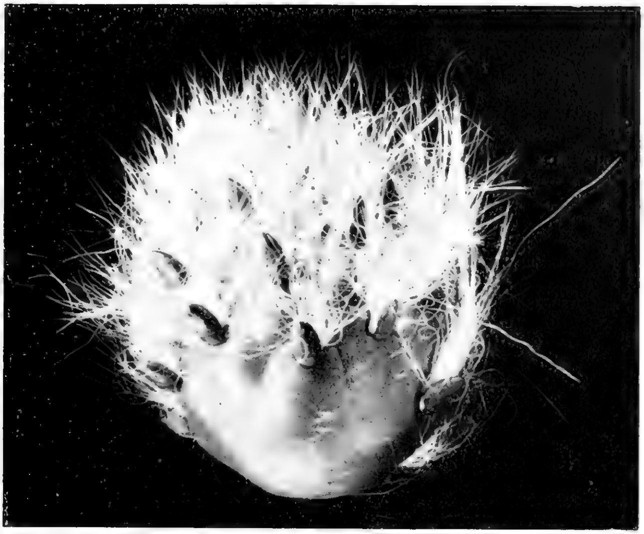
At a distance, a plain dotted with such clumps looks as if it were covered with grazing sheep. All cacti are highly specialized plants, adapted to live in places where there is very little moisture; but this cactus must be still more specialized, for it not only has to face the absence of water in the soil and air, but the effect of a high altitude, where the cold is intense at night but the sun excessively hot by day. The cactus here shown seems to be as well fitted for its environment as the polar bear is for the ice floes. (Fig. 3.)

ROOT SYSTEM OF THE CACTUS

Two mature plants of *Opuntia floccosa* on the rim of a gully. One of them has fallen into the gully but remains suspended by its strong tap-root. The root system of a cactus on the high Andean plateau must go deep into the earth, not only to get what little moisture there may be, but to anchor the plant firmly and prevent it from being blown out of the ground. (Fig. 4.)

A BRANCH CUT OPEN

The branch of *Opuntia floccosa,* shown natural size above, has been cut open lengthwise to show the succulent, watery interior, the covering of long, white hairs, the spines concealed among the hairs, and a fruit on the left side. The principal value of these hairs to the plant is probably to prevent excessive transpiration of moisture, under the powerful and drying winds so effectively intensified by the rarified atmosphere of the high plateaus.
Fig. 5



YOUNG BRANCH WITH LEAVES

The little conical buds shown on the above shoot, which is photographed natural size, are the true leaves of the cactus. They are soft in texture, and fall off before the branch has attained great size. They are mere vestiges of the leaves that the cactus had at some much earlier stage in its evolution, and at present they seem to serve no useful purpose. (Fig. 6.)

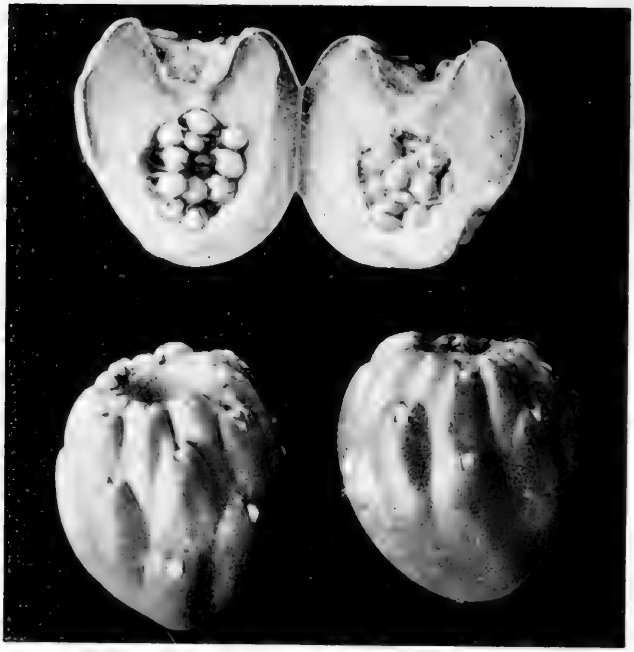
and sometimes closely covering square rods of surface like a coarse, woolly blanket. (Fig. 3.)

Although the "polar bear cactus" does not resemble its namesake in having exclusive possession of its peculiar environment, it may be a good example of adaptation. For, although two or three naked species grow even to so great an altitude as that of the summit of the Pass of La Raya, that is, at an elevation of more than 14,000 feet, they certainly show no such comfortable prosperity as the shaggy form. The naked species are relatively scarce and small. The Andine cactus flora would attract no attention from the traveler if the shaggy species were not there.

A NAKED FORM

One of the naked cacti is so closely related to the shaggy form as to be referred to the same species, *Opuntia floccosa*, by Dr. J. N. Rose, of the U. S. National Museum, the best authority on this group of plants. The difference may lie only in the length of the spicules, which are as short as in ordinary cacti. The existence of this naked form is another evidence that the shaggy coat is not indispensable, but the unclothed plants are much less common, and this indicates that the hair is distinctly advantageous. The naked plants appeared distinctly shrunken even at the beginning of the Peruvian winter, like our native *Opuntia vulgaris*, which grows as far north as Washington, D. C.; but the hairy Peruvian cacti were still plump and succulent, as in the specimen shown in Fig. 5, representing a photograph taken at Araranca, on the 13th of April, 1915.

According to Weberbauer this species extends northward from the Titicaca basin to about 10° south latitude. Another white hairy species, *Opuntia lagopus*, is found only in the region of Lake Titicaca. Weberbauer has published a photograph of the two species growing together in the vicinity of Poto,



FRUIT OF POLAR BEAR CACTUS

The fruit of *Opuntia floccosa* is here shown, natural size. It will be noted that while the plant is strongly protected by spines and hairs, the fruit is quite naked. Possibly this is to make it edible for animals and thereby promote the distribution of the seeds. The naked fruit is also better adapted to rolling down hill, and thereby spreading its seeds, than a spiny, hairy, fruit would be. (Fig. 7.)

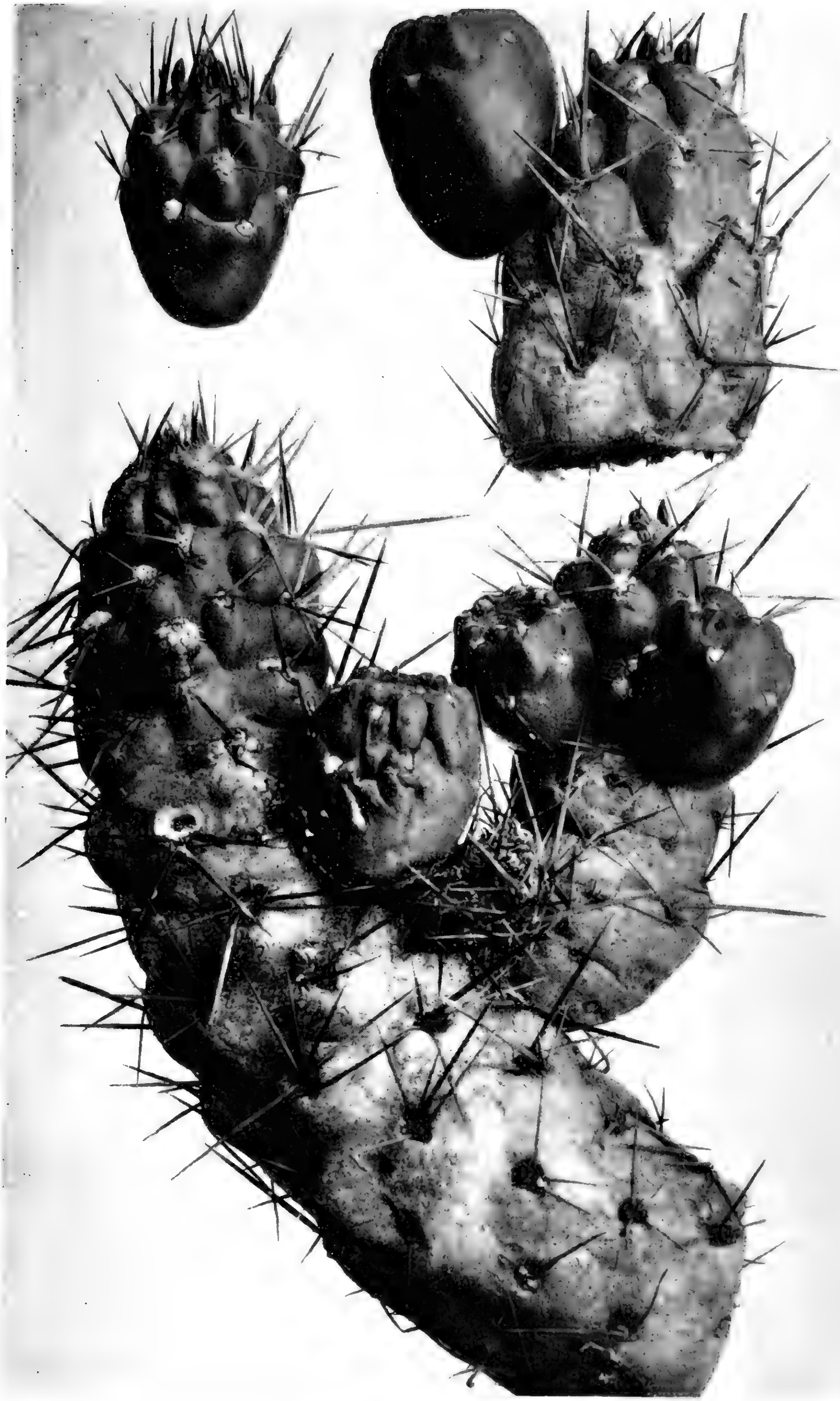
at an altitude of 4,500 meters, nearly 15,000 feet.[1]

One of the difficulties attending the study of adaptation is that of determining definitely the use of the specialized feature. Interpreting the uses of peculiar characters is a fertile field of speculation, as the history of the subject abundantly shows. Appearances are often very deceptive or, at least, have often proved very misleading. Finding a cactus with a shaggy coat on the bleak tablelands exposed to nightly frosts in winter has naturally suggested that the hairy covering is a protection against cold, but the fact may be quite the opposite. In the rare atmosphere of the highlands the sun has a scorching power that is probably much more trying to the plant than the cold. Even at temperatures above freezing, plants are often killed by too sudden exposure to the sun after a cold night, while those in shady situations survive. With stems and roots chilled, the demands of rapid transpiration cannot be met and the heated tissues collapse.

PROTECTION FROM THE SUN

With such facts taken into account it is easy to understand that a coat of hairs may be even more useful to keep the plants from warming up too suddenly than to be a protection against cold. The cooling of the plant may be somewhat retarded by the hairs, but this can hardly be of as much importance as the protection assured by the hairs against the injurious effects of sudden exposure to the heat of the morning sun. The practical bearing of this idea has been recognized by fruit growers who

[1] Weberbauer, A., 1911, Die Pflanzenwelt der Peruanischen Anden, p. 195, pl. 15.



THE RARE NAKED FORM

The cactus above shown (natural size) is closely related to the polar bear cactus—it has even been supposed to be the same species. It grows in the same localities as the hairy form hitherto shown, but is much rarer, and at high altitudes appears to be less thrifty. This suggests that it is unable successfully to compete with the more specialized and better adapted polar bear form, whose long hair gives it an advantage on the high Andean plateau. (Fig. 8.)

whitewash their trees in the winter to reduce the danger that sunny weather in spring may cause premature flowering and subsequent injury by freezing of the young fruits.

The analogy between the cacti and the polar bear may, then, be real. As a coat of white fur, because of its nonconductivity of heat and cold, may be useful to an animal that is exposed to the fierce sun in the long days of the arctic summer, so the dense hair of the shaggy cactus may serve as a protection against extremes of heat and cold. The development of shaggy coats in the Andine cacti is in line with the other specializations that they have adopted to enable them to exist under extreme conditions of exposure that plants of many other families are unable to tolerate.

Compared with most other flowering plants, the cacti are enormously specialized, the plant body being reduced to mere thickened stems. The leaves, which are such important organs in most of the flowering plants, are either lacking altogether or are represented in merely rudimentary form. In *Opuntia floccosa* the leaves are found only on the young shoots, completely hidden in the dense covering of hairs. They are the small cones with spiny tips that can be seen among the hairs in Fig. 6.

That adaptations are difficult to interpret does not mean that they are the less real. A single character may serve adaptive purposes in a variety of ways, the more the better, and, in the ability of plant and animal life to produce characters which lend themselves to environmental selection may properly be sought the explanation of the evolutionary processes which are the crowning marvel of life.

Economics and Eugenics

ESSAYS IN SOCIAL JUSTICE, by Thomas Nixon Carver, Ph.D., LL.D., David A. Wells Professor of Political Economy in Harvard University. Pp. 429. Price, $2.00 net. Cambridge, Harvard University Press, 1915.

Eugenics consists of a foundation of biology and a superstructure of sociology and economics. Galton emphasized the two parts in due proportion, but until recently sociologists and economists have been indifferent or hostile to eugenics, and have left it in the hands of biologists, who have naturally tended to emphasize the biological principles underlying eugenics, but have paid too little attention to their application. Prof. Carver (although he hardly alludes to eugenics by name) has made a valuable contribution to applied eugenics in these essays, in which he considers the nature of a strong state and the ways in which its strength may be increased. Starting from Darwinian principles, he concludes that properly controlled competition offers the best hope, but that direct action is also needed to limit the numbers of the unproductive and inefficient. The fundamental doctrines of economics are described in language free from technicalities and tested, in effect, by the criterion of eugenics. Those who are interested in seeing eugenic reforms actually put into effect cannot afford to overlook this book, which marks a very important step in the coördination of the various sciences which make up applied eugenics.

Growth of Provision for the Feebleminded

Describing the problem of caring for the feebleminded, Dr. Walter E. Fernald contributes a valuable review to the first issue of *Mental Hygiene*, the new quarterly magazine of the National Committee for Mental Hygiene. Most of the United States now make some provision for mentally defective persons, Massachusetts taking first rank in this respect, while Ohio, Minnesota and Iowa have always been leaders. In the following, there is no state institution of any kind for either feebleminded or epileptics: Alabama, Alaska, Arizona, Arkansas, Delaware, District of Columbia, Florida, Georgia, Louisiana, Mississippi, Nevada, New Mexico, South Carolina, Tennessee, Utah and West Virginia. In some of these, steps have been taken to remedy the lack.

EUGENIC ASPECT OF SEXUAL IMMORALITY

Those Affected Are Inferior In Eugenic Quality and the Decrease of Their Racial Contribution Is Directly a Gain Rather Than Loss—Social Hygiene Therefore Opposed to the Eugenic Movement[1]

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SO WIDESPREAD is the confusion in the minds of the general public as to the distinction between eugenics, sexual hygiene and the sexual purity propaganda that sexual morality is thought by some to be substantially synonymous with eugenics or to be included by it.

On a previous occasion[2] I have protested against this extension and modification of the valuable word "eugenics" as defined by Galton. It is my purpose here to analyze sexual immorality in order to see to what extent it may have eugenic and dysgenic effects.

Let us consider first whether sexual immorality increases or decreases the marriage rate of the offenders. We may conclude that it reduces the marriage rate. Although it is true that some individuals of less strong sexual passion might by sexual experience become so awakened as to be less satisfied with a continent life and might thus in some cases be led to marriage, yet this is more than counterbalanced by the following considerations:

1. The mere consciousness of loss of virginity has led in some sensitive persons, especially women, to an unwillingness to marry from a sense of unworthiness. This is not common, yet I have known of such cases.
2. The loss of reputation has prevented the marriage of the desired mate. This is not at all uncommon.
3. Venereal infection has led to the abandonment of marriage. This is especially common.
4. Illicit experiences may have been so disillusionary, owing to the disaffecting nature of the consorts, that an attitude of pessimism and misanthropy or misogyny is built up. Such an attitude prevents marriage not only directly, but also indirectly, since persons with such an outlook are thereby less attractive to the opposite sex.
5. A taste for sexual variety is built up so that the individual is unwilling to commit himself to a restriction of that variety.
6. Occasionally, threat or blackmail by a jilted paramour prevents marriage by the inability to escape these importunities.

We consider next the relative birth rate of the married and the incontinent unmarried. There cannot be the slightest doubt that this is vastly greater in the case of the married. The unmarried have all the incentives of the married to keep down the birth rate in addition to the obvious powerful incentive of concealment as well.

Passing to the relative death rate of the illegitimate and legitimate progeny, the actual data invariably indicate a decided advantage of the legitimately born. The reasons are too obvious to be retailed.

THE QUESTION OF QUALITY

Now then, knowing that the racial contribution of the sexually moral is

[1] Read in New York City at the thirteenth annual meeting of the American Genetic Association, December 27, 1916.
[2] Eugenics and So-called Eugenics. Am. Jour. of Sociology, July, 1914, Vol. xx, pp. 98–102.

greater than that of the sexually immoral, to get its evolutionary effect, it remains to compare the quality of the sexually moral and immoral.

For this purpose we should distinguish between the individual who is chaste till the normal time of marriage and then marries and whose sexual life is truly monogamous, and that abnormal group who remain chaste and celibate to an advanced age. Strictly speaking, these last are not moral, if they have valuable and needed traits, because their failure to reproduce affects decidedly adversely the welfare of their group in the long run. While the race suffers through the failure of many of these individuals to contribute progeny, probably in the long run it does not so far as males are concerned as much as might be supposed. Such individuals are often innately defective in their instincts or, in the case of disappointed lovers, may have a badly proportioned emotional equipment, since it leads them into a position so obviously opposed to race interests.

But, to pass to the essential comparison, that between the sexually immoral and the sexually moral as limited above, it is necessary first of all to decide whether monogamy is a desirable and presumably permanent feature of human society.

We conclude that it is:

1. Because it is spreading at the expense of polygamy even where not favored by legal interference. The change is most evident in China and India.

2. In monogamy, sexual selection improves valuable traits of character, rather than mere personal beauty or ability to acquire wealth; and

3. The greatest amount of happiness is produced by a monogamous system, since in a polygamous society so many men must remain unmarried and so many women are dissatisfied with sharing their mates with others.

Assuming this, then adaptation to the condition of monogamous society represents race progress. Such a race profits if those who do not comply with its conditions make a deficient racial contribution. It follows then that sexual immorality is eugenic in its result and that, if all sexual immorality should cease, an important means of race progress would be lost. We have an illustration in the case of the negro in America, whose failure to increase in number faster than whites is attributable to the widespread sterility resulting from venereal infection. Should venereal diseases alone be eliminated, we would expect that race immediately to increase in numbers faster than the whites.

It may be felt by some that this position would have an immoral effect upon youth if widely accepted. This need not be feared. On the contrary, I believe that one of the most powerful factors in ethical culture is pride due to consciousness of being one who is fit and worthy.

The traditional view of sexual morality has been to ignore the selectional aspect here discussed and to stress the alleged deterioration of the germ-plasm by the direct action of the toxins of syphilis. The evidence relied upon to demonstrate this action seems to me to be vitiated by the possibility that we had, instead, a transmitted infection to the progeny. We cannot then credit such an action since it is so highly improbable from analogy until it has been demonstrated in cases where the parents have been indubitably cured.

Is it necessary, then, to retain sexual immorality in order to achieve race progress? No, because it is only one of many factors in race progress. We can mitigate this as well as alcoholism, disease, infant mortality—all powerful selective factors—without harm, provided we make up for it by increased efficiency of other selective factors such as the segregation of defectives, more effective sexual selection, a better correlation of income and ability, and a more eugenic distribution of family limitation.

THE TEXAS PALMETTO

A Distinct and Valuable Species Which Has Been Destroyed So Rapidly That It Now Exists in Only One Grove—Desirable to Preserve It for Future Planting

IT IS not generally known that the largest palmetto palms in the United States are not in Florida or other Atlantic Coast States, but in southern Texas. The Texas palmettoes do not belong to the same botanical species as the Florida palms, but are quite distinct in general appearance as well as in botanical characters. The trunk is much more robust, the leaves are larger, the leaf segments are broader, and of firmer texture. The fruit has a sweet edible flesh surrounding the seed, like the fruit of the date palm.

The only natural grove of this interesting tree that now exists in the United States, or that is known to exist anywhere, is on the banks of the Rio Grande near Brownsville. Accounts of early settlers in the coast districts of South Texas indicate that the native palmetto extended in former years much farther north, where now only a few scattered individuals remain.

Botanists at first supposed that the Texas palmettoes were the same as the Mexican palmetto (*Sabal mexicana*), but afterward this was found to be a mistake and in 1901 the Texas palmetto was recognized by O. F. Cook as a distinct species, under the name *Inodes texana*. In addition to other differences, the Texas palmetto is a very much larger palm than the species to which the name *mexicana* properly belongs.

The Texas palmetto is also entirely distinct from the small, low-growing "scrub-palmettoes" of the river bottom forests of East Texas. These plants have only a few leaves, borne on slender subterranean or creeping stems, whereas the Texas palmetto is not only a truly arboreal palm, but is one of the most imposing of all the palms that are able to live outside the Tropics.

FEW HARDY PALMS

The entire palm flora of the world affords only a few hardy species that attain the proportions of trees and are suitable for planting in the warmer parts of the United States. The Texas palmetto represents an important addition to the series of hardy palms. It has been supposed that the Washingtonia palms of California are the hardiest of all, but the Texas palmetto is even more resistant to cold. Washingtonia palms have grown to maturity in several of the parks at San Antonio, Tex., but the leaves are often killed in cold weather that has no effect upon the leaves of Texas palmettoes standing in the same parks. Now that South Texas is occupied by a permanent and rapidly increasing agricultural and urban population, the time must soon come when the value and interest of a native palm, fully adapted to the South Texas conditions, will be highly appreciated. The preservation of the grove at Brownsville is necessary in order to insure an adequate supply of seed for general planting.

The prospective value of the Texas palmetto for ornamental planting in streets, parks and private grounds would amply justify the effort that is necessary to keep it from extinction. Palms are likely to have a special value in South Texas because plants of this family, like their relatives the grasses, appear to be immune to the root-rot fungus, which often destroys fruit and ornamental trees of other families.

The single remaining grove of the Texas palmetto, preserved in its original beauty, is situated 7 miles from the city of Brownsville in a location sheltered from the northers in a picturesque bend of the Rio Grande, which makes it still possible to perpetuate for coming generations this remarkable palm and the landscape scenery which its stately forms produce. This unique grove of palms is the property of Frank Rabb, of Brownsville, for some time collector of customs there.

VIEW IN THE LAST REMAINING GROVE OF TEXAS PALMETTO

This species is the largest palmetto in the United States. Because of its resistance to teredos, and other good qualities, the wood has been in demand for building wharves, and the species has been almost exterminated, the last remaining grove being preserved by Frank Rabb a few miles from Brownsville, Texas. The hardiness and disease resistance of the species make it of considerable value for planting, and its perpetuation should not be dependent on the public spirit of one man, as at present. (Fig. 9.)

ADZUKI BEANS AND JIMSON WEEDS

Favorable Class Material for Illustrating the Ratios of Mendel's Law—Actual Practice in Making Counts Is Necessary Before the Student Can Fully Grasp Modern Ideas of Heredity

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GENETICS is a difficult subject to teach without an adequate supply of demonstration and laboratory material.

Mendel's law, especially, is in need of illustration. It is like the law of valence in chemistry in that considerable practice in working out ratios is necessary before the student can appreciate and use these laws of definite proportions in predicting results. Counts of actual Mendelian ratios in the field or laboratory are as essential as the manipulation of test tube reagents in chemistry.

Two plants—the Adzuki Bean and the Jimson Weed—have been grown in the genetic section of the botanic garden at the Connecticut Agricultural College and have shown themselves especially favorable material for illustrative purposes in classes in genetics.

The two forms have been used also by several teachers to whom seeds have been sent. Their interest in such material seems to warrant the publication of the present brief paper on the availability of these plants for class purposes.

THE ADZUKI BEAN

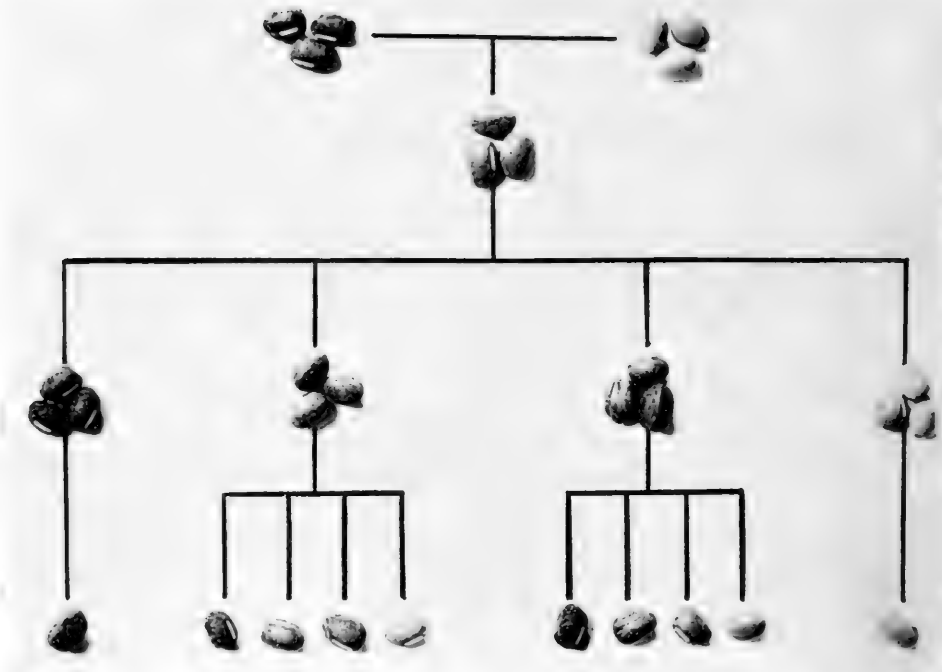
The Adzuki Bean (*Phaseolus Mungo*) is especially desirable as a form with which to introduce the student to Mendel's law.

Pedagogically it is better, we believe, to start with the 1:2:1 ratio rather than with the 3:1 ratio. In the Adzuki Bean, mottling in the seed coat is dominant to lack of mottling. In the hybrid or heterozygous condition, however, the mottling is lighter than in the pure or homozygous condition. Races occur with red seed coats but the difference in mottling shows best on gray seeds. Heterozygous plants, therefore, can be readily distinguished from homozygous plants by an inspection of the seeds which they produce. It should be remembered, however, that the seed coats are maternal characters and do not indicate the genetic composition of the embryos which they enclose.

Fig. 10 shows the expected results from a cross between a plant bearing dark mottled gray seeds and one bearing unmottled gray seeds. The dark mottled and the unmottled gray seeds breed true when selfed while the light mottles break up into a 1:2:1 ratio in each generation. If the intensity of mottling is disregarded this 1:2:1 ratio becomes the more familiar 3:1 ratio. Fig. 11 shows the result that might be expected from crossing a homozygous dominant (dark mottled) with a heterozygous dominant (light mottled) plant. The offspring show all dominant if the presence of mottling is alone considered or a 1:1 ratio if the grades of mottling are distinguished. Similarly in Fig. 12 are shown the expected results from crossing a heterozygous (light mottled) plant with a recessive (gray unmottled).

For class purposes we have never taken the trouble to make crosses since experience shows that off-pollination rarely occurs in these forms.[1] We have grown them thus far three seasons and have found that light mottled seeds always segregate, giving a 1:2:1 ratio

[1] In one instance we found occasional plants appearing with red seeds in a pedigree where only grays were expected. Selfing the plants in this pedigree showed that the white seed coat is dominant to red seed coat and that off-pollination must have occurred in a previous generation.



INHERITANCE OF MOTTLING ON SEED COAT

Seeds of four generations of the Adzuki Bean are arranged above to show how the mottled character of the seed coat is inherited in accordance with Mendel's law. In the original parental generation, at the top, plants bearing dark mottled seeds are crossed with those bearing unmottled seeds. The offspring (F_1) all have light mottled seeds. These F_1 plants, self-pollinated, produce on the average in the F_2 generation one plant with dark mottled seeds, two plants with light mottled seeds and one plant with unmottled seeds. The dark mottled and the unmottled F_2 plants breed true, while the light mottled ones break up in the F_3 generation giving again a 1:2:1 ratio for the mottling of seed coats. Seeds slightly reduced in reproduction. (Fig. 10.)

while the dark mottled and the unmottled forms breed true when selfed. This is so both for forms with red and with gray seeds.

The 1916 records for offspring from light mottled seeds from four different lines are given in Table I below:

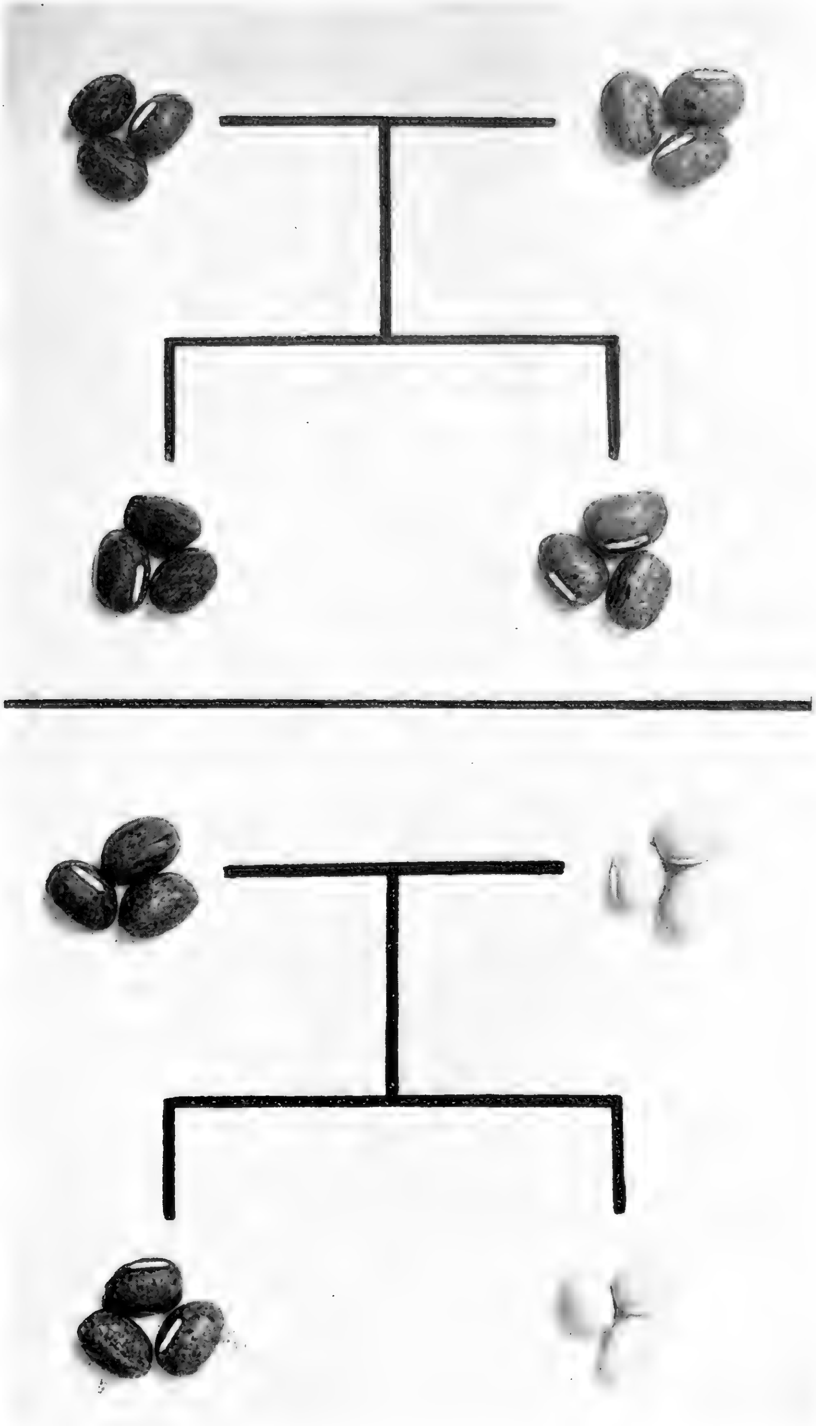
TABLE I

Pedigree number	Dark gray mottled	Light gray mottled	Gray not mottled
A-8..........	60	114	57
A-17.........	5	9	11
A-18.........	44	100	52
A-31.........	21	38	24
Total.......	130	261	144
Expectation...	133.75	267.50	133.75

This gives a total of 391 mottled to 144 grays—a ratio of 2.72:1. Plants that bear mottled seeds—either homozygous or heterzygous—have red pigment in their stems. This is most noticeable in the seedlings and in plants that are ripening their seeds. Seeds may be germinated in the laboratory to show the uniformity of seedlings from homozygous plants, and segregation into a 3:1 ratio from heterozygous plants. Adzuki Beans should be planted out early since they are rather slow in maturing their seed.

THE JIMSON WEED

The Jimson Weed is of value from the ease with which it can be handled. It may be grown to maturity in a 3-inch pot or, if given good garden conditions,



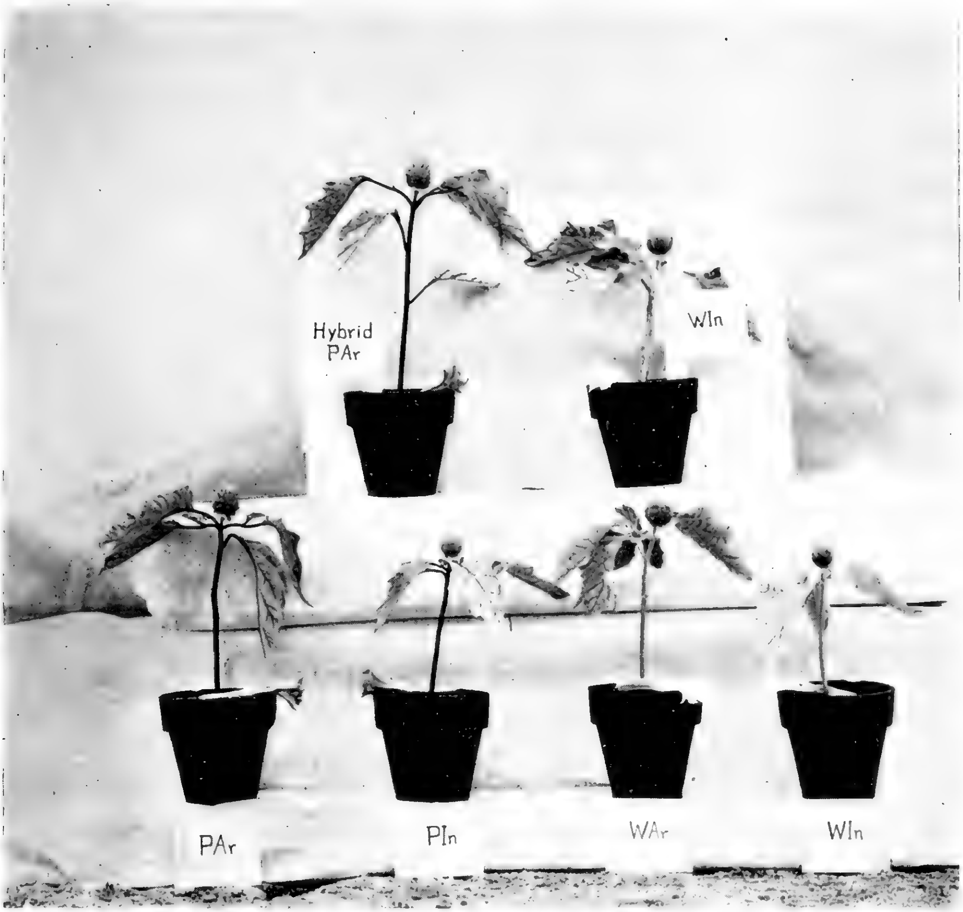
TWO CROSSES OF ADZUKI BEANS

The photographic diagram above shows the result to be expected from crossing a homozygous dominant (dark mottled) plant with a heterozygous (light mottled) one. The parental types of seed-coat are reproduced in the offspring in equal numbers. Seeds slightly magnified in reproduction. (Fig. 11.)

Below is shown the result to be expected from crossing a heterozygous (light mottled) plant with a recessive (unmottled one). Again the parental types appear in the simple and familiar 1:1 ratio. Seeds slightly magnified in reproduction. (Fig. 12.)

A CROSS OF TWO CONTRASTED CHARACTERS

Jimson Weeds arranged to show the average results of a dihybrid cross between a purple-flowered, purple-stemmed plant with armed capsules (PAr) and a white-flowered, green-stemmed plant with *inermis* capsules (WIn). The F_1 plants (of which only one is shown) are all purple armed, while the expected segregation of the F_2 generation shows 9 purple armed, 3 purple *inermis*, 3 white armed and 1 white *inermis*. One of the advantages of the Jimson Weed, for classroom use, is that it can be grown successfully in a 3-inch pot, and a single flower will produce five or six hundred seed (Fig. 13.)



THE SIMPLEST RATIO IN A DIHYBRID CROSS

Living diagram showing the result of crossing a heterozygous purple armed Jimson Weed (Hybrid PAr) with a double recessive (WIn). Each of the four possible classes of progeny (described under the preceding figure) is equally represented, giving a 1:1:1:1 ratio. (Fig. 14.)

has been grown to a height of over 6 feet. It is self-fertile and selfed seed may be obtained by merely bagging the unopened flowers. A bud may be castrated just before the stamens open and the stigma pollinated at once from another unopened bud. Thus the time consumed in making crosses is reduced to a minimum. A single cross-pollinated flower, moreover, may produce upwards of 600 seeds. The productivity is enormous. A single vigorous plant may have a diameter of over 6 feet and has been estimated to produce around 50,000 seeds. Students have figured out that if all seeds were sown and grew to plants of the same size and productiveness, it would take only five generations at this rate, including the first plant, to cover the entire surface of the earth, both land and water, and there would be left over sufficient seed to sow several of the planets in addition.

As found growing wild, Jimson Weeds occur in two color forms. Those with green stems and white flowers have been called *Datura Stramonium*, while those with purple stem and purple flowers are called *D. Tatula*. They hybridize readily, however. The color of the stems shows as soon as the plants break ground in the seed pan. The purple color is dominant; selfed seed from plants heterozygous for stem color

therefore should give a 3:1 ratio which can readily be demonstrated in boxes in the laboratory. When grown in the greenhouse, it has been found possible to distinguish heterozygous from homozygous purple plants by differences in the intensity of coloration in the flowers. When grown in the open, however, the differences are not so readily recognized.

There is an unarmed race (var. *inermis*) with smooth capsules. The smoothness of the capsules acts as a recessive to the spiny character in the

TABLE II

(*a*) Dihybrid Crosses—F_2 Offspring. Expected Ratio—9 : 3 : 3 : 1

Parentage		Purple armed	Purple *inermis*	White armed	White *inermis*
Plants heterozygous for both purple and spines, either selfed or intercrossed. Genetic formula—PpAa×PpAa	Recorded	698	228	223	78
	Expected	690.3	230.1	230.1	76.7

(*b*) Dihybrid Crosses—F_1 × Double Recessive. Expected Ratio—1 : 1 : 1 : 1

Parentage		Purple armed	Purple *inermis*	White armed	White *inermis*
Plants heterozygous for both purple and spines, crossed with plants recessive for both of these characters. Genetic formula—PpAa×ppaa	Recorded	89	86	99	88
	Expected	90.5	90.5	90.5	90.5

(*c*) Monohybrid Crosses[2]—F_2 Offspring. Expected Ratio—3 : 1

Parentage		Purple	White	Armed	*Inermis*
Plants heterozygous for purple, either selfed or intercrossed. Genetic formula—Pp×Pp	Recorded	2606	914	....	....
	Expected	2640	880	....	....
Plants heterozygous for spines, either selfed or intercrossed. Genetic formula—Aa×Aa	Recorded	....	....	987	327
	Expected	....	....	985.5	328.5

(*d*) Monohybrid Crosses[2]—F_1×Recessive. Expected Ratio—1 : 1

Parentage		Purple	White	Armed	*Inermis*
Plants heterozygous for purple, crossed with plants recessive for that character. Genetic formula—Pp×pp	Recorded	801	811	....	....
	Expected	806	806	....	....
Plants heterozygous for spines, crossed with plants recessive for that character. Genetic formula—Aa×aa.	Recorded	....	....	278	243
	Expected	....	....	260.5	260.5

[2] There are included here the records for stem and spine characters abstracted from the dihybrid summaries given in the table above.

commoner armed form (var. *armata*). Capsule peculiarities, of course, cannot be recognized in the seed pan, but the character of the capsule can be discovered early in the bud by dissection.

The color of the stem and the character of the capsule can be conveniently combined to give a dihybrid ratio. A living diagram showing the P_1, F_1 and F_2 in such a dihybrid cross is shown in Fig. 13, while a diagram showing the results of crossing a heterozygous plant with a double recessive is shown in Fig. 14. A report on these characters has no novelty. They were used in Naudin's early hybridization studies and their inheritance has already been investigated by Bateson and Saunders.[3]

A summary, given in Table II, of the data on pigmentation and capsule characters, incidentally obtained in connection with other studies, will indicate the closeness of the ratios to expectation.

A study of variability in the Jimson Weed is being carried on under the direction of the senior author and he would be glad, therefore, to receive material of any striking peculiarities that may be found in this genus.

An excess stock of seed of both Adzuki Beans and Jimson Weeds has been accumulated which may be expected to throw the ratios discussed in this paper. The writers would be glad to send such material to teachers who may request it so long as the material lasts.

More Schemes to Increase Population of Germany

German writers continue to occupy themselves with plans for making good the losses of the war in population. P. Mayet, writing in *Medizinische Reform* (xxii, Nos. 11–13), sets forth a detailed program in six parts:

1. Corresponds to the American Infant Mortality Movement.

2. Special methods for reducing the loss of illegitimate children, among whom the death rate is always high.

3. A comprehensive plan for the physical and intellectual education of youth, to make them more fit for marriage and parenthood.

4. Exclusion of celibates from all public office. It is calculated that this measure would yield an increase of 30,000 births a year.

5. Increase of birth rate by (*a*) fighting venereal diseases and (*b*) giving premiums for each child above three, etc.

6. Insurance schemes to make it financially possible for parents to bring up more children.

However effective such methods might be for increasing the German population, it is hardly necessary to point out that they would, on the whole, produce quantity at the expense of quality.

Study of Egg-Production in Poultry

As a result of five years' breeding of Rhode Island Reds at the Massachusetts Agricultural Experiment Station, H. D. Goodale finds:

First, that the prime factor essential for satisfactory winter egg production from strong stock is early maturity. The records of the station flocks show that, even in the case of birds of one breed hatched from eggs from the same pen supposedly made up of birds of similar breeding, there is an astonishing variability in the age at which the first egg is produced, namely from 195 to 300 days.

Second, the prime factor essential for high annual egg production aside from early maturity is nonbroodiness. A considerable flock of Rhode Island Red hens, none of which was broody during her first year, has been selected and will be used for breeding in the effort to produce a nonbroody strain. Dr. Goodale concludes that if broodiness can be eliminated, the increase in annual egg production may very likely amount to as much as 33⅓%.

[3] W. Bateson and E. R. Saunders, Report to Evolution Committee of the Royal Society, p. 21. 1902.

THE HEN'S ANNUAL VACATION

Scarcity of Eggs in Early Winter Due to Natural Causes—Early Hatching of Pullets Will Result in Egg Production at the Desired Time

GEORGE M. ROMMEL

Chief, Animal Husbandry Division, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.

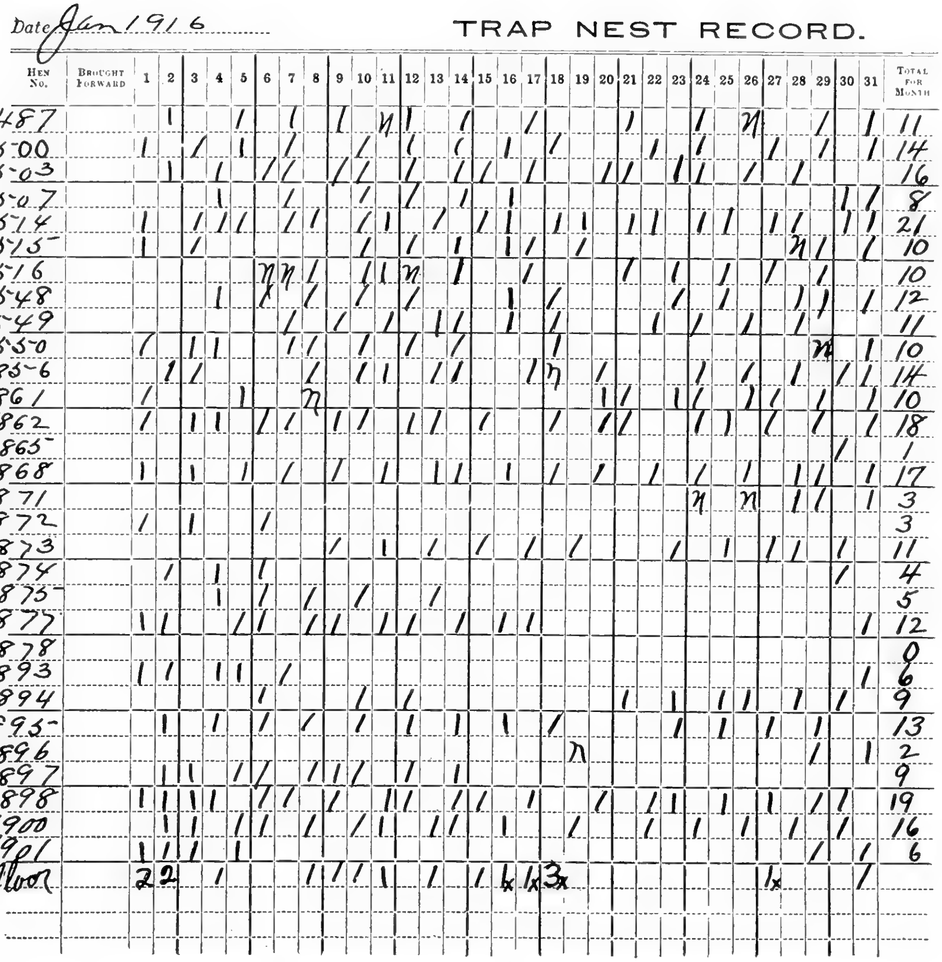
IN THE fall of every year, beginning about September 1 and continuing until about New Year, we have what the newspaper reporters picturesquely call a "hen strike." Fresh, new eggs almost disappear from the market stalls. Prices mount upwards with startling agility and never is the appetite for fresh eggs so keen as at this time. To satisfy our appetites we are offered eggs of all sorts, under all kinds of names, but most of them, in the language of the darky waiter, "just won't poach, nohow." Our wives talk learnedly of "no-egg cakes" and how to clear the coffee without an egg shell; editors seize their pens in denunciation of the egg trust, committees of women's clubs are organized to study the situation and the subject even gets a hearing on the floor of Congress.

The reporters' designation carries a grain of truth but really does the hen an injustice. In fairness to her, we should not call this a "strike"; it is a vacation in wholesale, indulged in by every hen of discreet age. It is nature's way of preparing the hens for another season of egg laying and safeguarding the perpetuation of the species.

Egg production, like milk production, is a physiological function, a phase of the reproductive process which man has turned to his own advantage. In a state of nature, the time of egg-laying corresponds rather closely to the passing of winter and the approach of spring. Spring, therefore, and early summer months are the periods of greatest egg supply. When the physiological necessity for a maximum output of eggs ceases to make its call urgent, the hen's egg-laying machinery relaxes and ultimately stops for a well-deserved rest. She changes her feathers (molts) and, with the most serene perversity imaginable, absolutely refuses to lay another egg until she gets ready. Why should she? Fall-hatched chickens would probably not survive the winter and, if they did, would be puny, stunted, and of little value. From this time until the lengthening days signal the return of spring, the hens enjoy their annual vacation. This has always been the way of hens and it always will be. Let us see what can be done to control this habit with the least possible inconvenience to the hens and the greatest benefit to human beings.

HABITS OF THE HEN

A brief consideration of the habits of hens in egg laying shows how seriously this affects the fresh egg supply. Every one knows that a 200-egg hen is a creature of mark and distinction. The famous and late-departed Lady Eglantine is reported to have laid 314 eggs in a single year. If the days that Lady Eglantine did not lay are put in a row, we have a period of fifty-one days during the year when she was idle. A "200-egger" would have 165 days vacation charged to her. Now records like these are extremes—at the top of the list. Probably no flock of any size has ever averaged 200 eggs per year for each female, or even for each pullet in the flock. The average annual production for the whole country is somewhere between 50 and 70 eggs. Average records of 130 to 150 eggs in carefully managed flocks are exceedingly good and are usually confined to the pullets, which always lay better than the mature hens. Even in the best of flocks, with, say, as good an



A GOOD EGG YIELD WHEN EGGS ARE MUCH WANTED

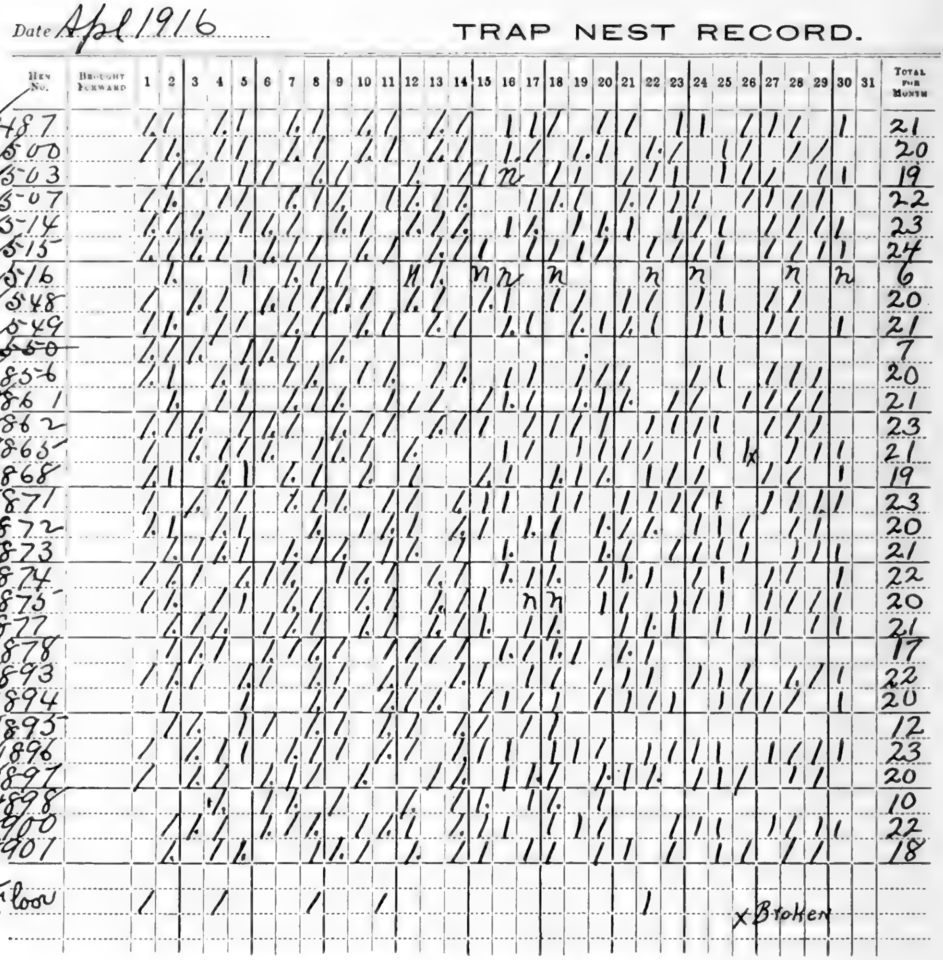
Facsimile of the egg report for a pen of pullets during January, 1916. This shows an average daily yield of over ten eggs for the entire pen of thirty pullets—technically over 34 per cent. Three hundred and nineteen eggs were laid during the month. The bottom line "Floor" is the report on eggs laid on the floor which, of course, could not be credited to any particular pullet. *X* signifies broken eggs; *N* signifies that the bird went to the nest but did not lay. Record from experimental farm of the Bureau of Animal Industry. (Fig. 15.)

average output as 150 eggs, there will be an average annual charge of 215 days idleness against the hens and pullets in the flock, a total of over seven months.

Fortunately for us, the hens do not insist on taking all their vacations in a lump. They spread them out, as the trapnest records in Figs. 15 and 16 show. Some hens lay one day and rest the next; others lay three or four days, rest one or two days and then get to work again. All this helps to distribute the egg supply somewhat, and to reduce the total period of inactivity which the molting season inevitably causes.

THE REMEDY

Such being the facts, can the habits of hens be adapted to the requirements of human beings to make the egg supply more steady than it is at present? We get some help from the hens in their



MORE EGGS, BUT NO MORE MONEY

Facsimile of the egg report for the same pen during April, 1916. Bird No. 550 was killed by a hawk on the ninth; bird 1878 laid the last egg on the twenty-second; bird 1895 on the eighteenth. These birds were missing at the next weigh-day. April is the month of heaviest production. The birds are vigorously responding to nature's call. The total production for this pen for the month is 583 eggs. Eliminating the three birds mentioned, the production is 547 eggs, an average of over twenty eggs daily, and a percentage of almost 68. Every one's hens are laying now, however, and the total value is no more than in January. *N* signifies that the bird went on the nest but did not lay. *X* signifies that the egg was broken. Eggs laid on the floor are shown on the bottom line. The dots have no significance. Record from experimental farm of the Bureau of Animal Industry. (Fig. 16.)

habit of spreading out the egg-laying period by occasional short rests. To meet the situation, however, we must rely on simple and definite rules of flock management.

HATCH CHICKENS EARLY

The first and most important of these rules is "Hatch Chickens Early." Egg laying begins in young pullets at quite definite periods. In breeds of the American class, such as Plymouth Rocks, Wyandottes, Rhode Island Reds, etc., pullets begin to lay at an average age of 7 months. The Mediterranean breeds (Leghorns, Minorcas, etc.) begin laying a month sooner, when about 6 months old. So, if we want to

GETTING AN EARLY START

The mother hen shines as a brooder, although she may not be broody when needed. A hen can brood more chickens than she can hatch; so hens as brooders may supplement the incubator. The usual number of eggs in a sitting is fifteen; this hen is brooding twenty-one chicks. Photograph from Bureau of Animal Industry. (Fig. 17.)

meet the scarcity caused by the molting of the hens, we should time the hatching so that the pullets begin laying when the hens begin molting. To be on the safe side, the poultry experts advise spreading the hatching over two months so that pullets of different ages are coming on and the eggs are not "all in one basket."

DEVELOP THE PULLETS

The second rule is "Develop the pullets properly." Here we are in rather more danger of overdoing than of underdoing. Of course, pullets to do well as fall and winter layers must be vigorous, thrifty and well developed. The temptation of the amateur is therefore to feed too well and his pullets "begin too strong," start laying with a rush, molt, and begin a heartbreaking imitation of their elders. Considerable skill is required in handling this matter. Rules cannot be laid down which can be followed implicitly. The beginner must learn as much as he can from the experience of others and a study of his own flock, so that the mistakes of one year may be turned to advantage later.

GOOD HOUSING IMPORTANT

The third rule is "Furnish good quarters for the following winter; feed liberally when laying begins." After the pullets have begun to lay the management of the flock has much to do with a steady, continuous supply of eggs. Exposure to cold and storms

FOR EARLY HATCHING, INCUBATORS ARE DESIRABLE

Although an incubator involves some initial expense, it is always ready when wanted. Breeders cannot afford to take any chances of having their chickens hatch too late, and if they depend on hens, the hens may not be inclined to broodiness when they are needed. An incubator is always broody. Photograph from the Bureau of Animal Industry. (Fig. 18.)

will stop egg laying immediately. A hen will not lay an egg in day time when her feet get cold and her comb frozen at night. Trees are bad roosting places if pullets are to lay.

Houses do not need to be expensive; even an old piano box, if tight, makes a good house for a small flock. The houses must be free from drafts, they should have curtain fronts for ventilation and the floors must be dry and well covered with litter. When storms come, keep the birds indoors and feed a little more.

AGAIN—"HATCH EARLY"

All this is of no avail if the dates are wrong. If a pullet is hatched on June 1, she is timed to begin laying not before November 15, no matter of what breed she may be nor how she may be handled, and the chances are she will not begin before January 1. If she is hatched on May 1 and is a Leghorn, well fed and housed, she will probably begin to lay between October 15 and November 1 and will keep up the good work all winter long. By careful timing of hatching so that pullets come at intervals from March 1 to April 30, the problem of a winter egg supply is on a fair way to solution.

Before proceeding further in the discussion, certain correlated benefits from early hatching should be pointed out. The poultry raiser who hatches his chickens early has the advantage in every respect over his neighbor who lets nature take her course; not only do his pullets make good as winter layers, but the young males can be sold as broilers when the broiler market is at its best. Furthermore, the early hatched bird makes better growth, is more thrifty and is more resistant to disease than the late-hatched one. If the poultryman raises standard-bred fowls, his best advertising will come from exhibiting at the poultry shows. Here growthiness, vigor and size for age are essential. These features, of course, are almost out of the question

A WELL-EQUIPPED POULTRY PLANT OWNED BY THE U. S. DEPARTMENT OF AGRICULTURE

The above photograph shows young birds on range at the Government Poultry Farm, Beltsville, Md. The chickens are of various ages. The large structures at the left are brooder houses. The small structures in the center with half-pitch gable roofs are self-feeders, where the chickens may eat when hungry. The remaining structures are ordinary colony houses for growing birds. All are portable. Pullets go from this range direct to the laying houses. Photograph from the Bureau of Animal Industry. (Fig. 19.)

GOOD SPECIMENS OF A FAVORITE BREED

A flock of spring-hatched Barred Plymouth Rock pullets on the Bureau of Animal Industry's Experimental Farm at Beltsville, Md. The photograph was taken in the fall just as they were beginning to lay. (Fig. 20.)

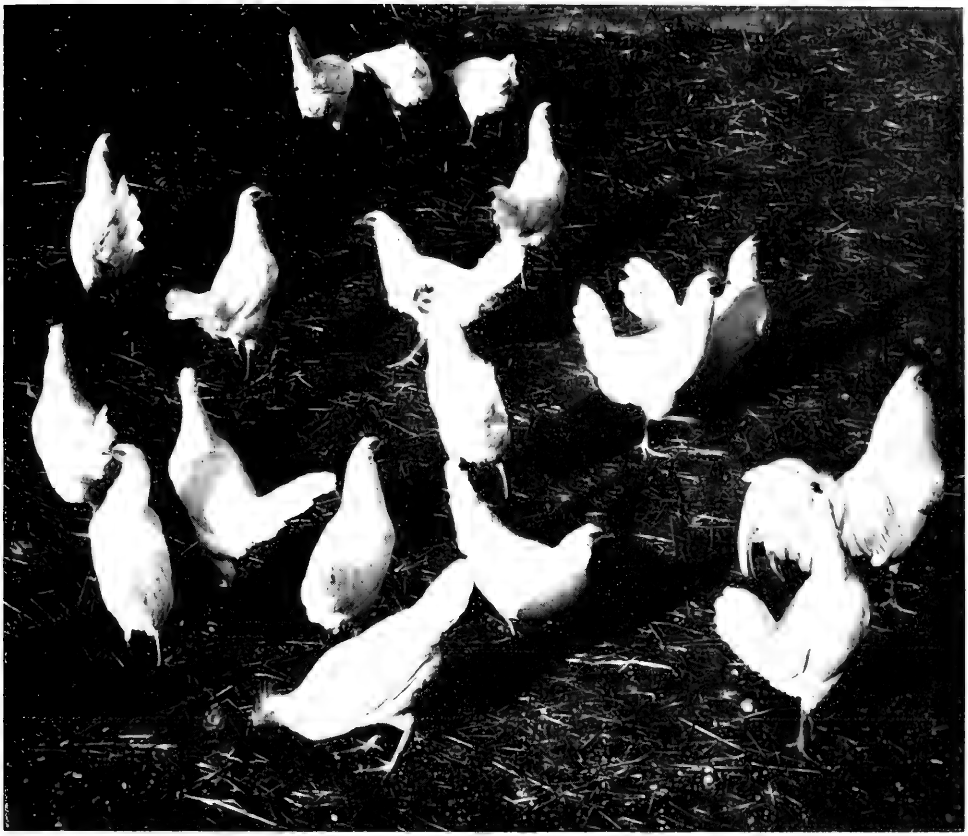
in late hatched stock. From every standpoint, therefore, early hatching is profitable to the poultry raiser.

DIFFICULTIES IN THE WAY

So far as the question of early hatching is concerned, the principal problem is to get the eggs properly and promptly incubated. If the poultry raiser has an incubator, he will be able to hatch when he pleases. If he depends on hens, and has never hatched early, he must get broody hens elsewhere. Like egg-laying, broodiness in hens is part of a cycle. Right now, for example (February 14), the hens are not broody because they are not through laying, and they are not through laying because they did not begin laying early; they did not begin laying early because they were hatched too late. Once we get the magic circle broken and change the dates on the hens, we will have plenty of broody hens when we need them. The only exceptions will be with the Mediterranean breeds, the hens of which do not have so great a tendency to become broody as those of the American breeds.

IS SUCCESS POSSIBLE?

Poultrymen who have tried it, agricultural colleges, and the U. S. Department of Agriculture, are confident that a concerted, systematic effort on the part of poultry raisers would help to prevent the annual fall and early winter scarcity of fresh eggs.



A POPULAR BREED OF EGG-PRODUCERS

No fowl is more widely known and liked for egg-laying than the Single Comb White Leghorn, but it will not be as valuable to its owner as it should be, unless it is hatched early. The above photograph of part of the Bureau of Animal Industry's flock at Beltsville, Md., shows the appearance of the pullets in their first fall, when they were beginning to lay, at a period when eggs were scarce and high in price. (Fig. 21.)

The records of any well-managed flock demonstrate this fact. For example, in the flock of the Bureau of Animal Industry, 220 pullets averaged 27½% daily egg production during November, December and January last. That is to say, the egg production of these pullets was better than one egg every day for every four hens. These pullets averaged 16% in November, 25% in December and 40% in January. The best pen of thirty birds averaged 30% in November (nine eggs daily), 35% in December (better than ten eggs daily) and 30% for January. One other pen of thirty birds made a record of 50% in January, but had not laid so well in the preceding months. These were the best and earliest pullets in the Government flock, but the yield for the entire flock of 650 pullets was better than 20% (one egg daily for every five pullets). Now the important part of this to the poultry raiser (and to the consumer as well), is that this production was being accomplished when fresh, new-laid eggs were selling at unheard-of prices in Washington. For weeks during this period fresh eggs brought over 50 cents per dozen and at one time they sold for 75 cents per dozen. The same was true in other cities. Such a market should attract the producer because these prices yield a very good profit. Of course, if a large number of poultrymen went into

AT THE END OF A PRODUCTIVE SEASON

A Rhode Island Red hen beginning to molt. She is at the end of her "pullet year," in which she laid 142 eggs, fully twice the average for all hens in the United States. Her feed consumption in this time is shown in the photograph, which was made by the Bureau of Animal Industry on its farm at Beltsville, Md. (Fig. 22.)

NO INDUCEMENT TO EGG LAYING

A pullet will not lay when her feet are cold and her comb is frozen. This is a fair example of much of the housing provided for poultry in the United States. Photograph from the Bureau of Animal Industry. (Fig. 23.)

CHEAP BUT SATISFACTORY HOUSING

A poultry house need not be expensive to be efficient. An enterprising grower in a Washington suburb uses piano boxes with excellent results. Photograph from the Bureau of Animal Industry. (Fig. 24.)

fall egg production the price would be lower, in which case the consumer would benefit.

PUBLICITY CAMPAIGN UNDER WAY

Public agencies are now engaged in a propaganda to induce poultry keepers to increase the supply of fall and winter layers. Kansas, a State in which the poultry industry has great commercial importance, has already taken what is believed to be the first official step of this kind. The Agricultural College is behind the movement. The Federal Department of Agriculture is now going into the matter. Articles are being furnished the press and circulars distributed to the public showing the advantages of fall egg-laying. The problem is a national one, intimately affecting the food supply; therefore the Federal Government's interest. It is of the greatest importance to city dwellers everywhere who are largely dependent on nearby sources of supply for fresh eggs; hence the interest of the State governments.

The Federal Department of Agriculture takes a great deal of satisfaction in the outcome of its infertile egg campaign. This has been accomplished largely by printers' ink and pictures, and has established quite generally the practice of producing only infertile eggs in summer. The support of the trade, transportation companies, warehousemen, the agricultural colleges and state officials has made that campaign such a success that the superior keeping qualities of the infertile summer egg are now a matter of common knowledge and the production of infertile eggs in summer is a common practice. The keynote of the success was a simple rule of poultry management. By observing this rule, anyone can produce infertile eggs. The production of fall and winter laying pullets is based on a rule which is equally simple, although it requires more attention to details of management for its successful application. The two are very closely correlated. To produce infertile summer eggs, remove all male birds on May 1.

WHERE THE GOVERNMENT'S HENS LIVE

The main laying house at the Government poultry farm. The curtains are down in one compartment. The only purpose served by glass is to admit sunlight. The curtain acts as a ventilator. If the hen-house has a curtain in front of the roosts, fowls will be comfortable in the coldest weather provided the house is properly constructed otherwise. Photograph from the Bureau of Animal Industry. (Fig. 25.)

To produce winter laying pullets, hatch all chickens not later than May 1. Poultry keepers should keep this date firmly in mind, and let the year of their flock operations revolve around it. For southern localities, earlier dates should be selected, until we reach the Gulf States, when hatching may begin as early as December.

Every part of the country suffers from the effect of the hen's annual vacation. The time of its occurrence varies with the latitudes, but its regularity of appearance in a given section is as certain as seedtime and harvest. If we must have really fresh eggs during the entire year, we must furnish pullets to serve as substitutes for the molting hens and distribute the egg yield as evenly as possible throughout the year.

To summarize the foregoing remarks, these are the three simple rules for fall and winter egg production:

1. Hatch chickens early—between March 1 and April 30.
2. Develop the pullets properly.
3. Furnish good quarters for the following winter; feed liberally when laying begins.

A Valuable Collection of Reprints

W. J. Spillman, of the U. S. Department of Agriculture, has presented to the Journal of Heredity a collection of several hundred reprints, covering most of the progress of genetics from the rediscovery of Mendel's law to 1912. The gift is most welcome because the collection of reprints already in the office of the Association dates from 1913. The editor takes this occasion to remind workers in the field of genetics that reprints of their publications are always received with pleasure, and made part of the permanent library.

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and hand it to some friend who is interested in plant-breeding, animal-breeding, or eugenics.

Application for Membership

I enclose $2............for annual membership dues in the American Genetic Association. Please enroll me for one year from date. It is understood that I will receive the Journal of Heredity every month without further cost. My interest is chiefly in the subject I have marked with X.

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The

Journal of Heredity

(Formerly the American Breeders' Magazine)

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Date of issue of this number, MARCH 28, 1917.

THE OLDEST KNOWN ANIMAL

It is a mistake to think that evolution has meant the death or change of all the life forms which were in the world in early geologic ages. Some of them have persisted, practically unchanged, for a hundred million years or more.

No living animal has a longer pedigree than Lingula, the shell-fish shown at the left above, photographed natural size from a specimen taken a few years ago in Manila Bay and supplied by Dr. Paul Bartsch. At the right is a fossil, also natural size, but with the peduncle or "tail" restored, from the Ordovician period, after Billings. The Ordovician is not the lower limit of Lingula's history, however: "The genus commences to be represented in the Cambrian rocks, and has continued without interruption, and with no perceptible change, to the present day."

That this genus should have survived for all these ages, and undergone practically no change, is striking evidence of the fact that the germ-plasm, under some conditions at least, is extraordinarily constant. (Frontispiece.)

IMMIGRATION AFTER THE WAR

United States Faces Great Eugenic Problem—Passage of New Law to Regulate Immigration Marks Great Advance—Essential Features of the Act[1]

Robert De C. Ward

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THERE is widespread anxiety concerning the "dumping" of cheap European goods on our markets after the war is over. Of infinitely greater importance is the "dumping" of cheap European labor upon our shores after the war is over. Goods from abroad concern pocketbooks only. Human beings from abroad enter into our national life. They contribute to the blood of the future American people. They determine what our race is to be. It is the cargoes of men, and women, and children, not the cargoes of goods, that are the real problem.

We have reached a critical point in our immigration policy. The war has brought us suddenly face to face with a great experiment in restriction. The inflowing alien tide has, however, by no means ceased altogether. During the period since the war began roughly about 1000 immigrants a day have landed on our shores.[2] One thousand a day means over 300,000 a year. A few decades ago, that was a large annual immigration. It only seems small in comparison with the much larger numbers—over a million a year—who have recently been coming. Under ordinary conditions, nearly three-quarters of our immigrants are southern and eastern Europeans, but during the past two years the proportion from the British Isles, Holland, Denmark, the Scandinavian countries, from all of which there has been a fairly regular steamship service, has risen, while the proportion from many of the countries of southern and eastern Europe, and from Germany, has fallen. Italy has kept on sending about her usual high percentage. Greece, owing to the threat of war, has jumped to a surprisingly large figure. Spain and Portugal have sent us many who are fleeing from possible military service. From the war-ravaged Balkans hundreds of people have already come. The flotsam and jetsam from the disturbed conditions in Europe and Asia Minor—the backwash of the war—has begun to find its way to our shores. From Syria, from Turkey, from Armenia, from Egypt, from Greece, from Siberia, have come refugees—the first trickles of the vast stream that will flow here when the war is over.

SENTIMENT NO SOLUTION

When refugees from war-stricken Europe are mentioned, there naturally arises in our minds the thought: "Is it right for us to prevent any of these people from coming here? Is it not un-American?" This question each must answer for himself. My own convictions are perfectly clear on the matter. I do not believe that sentiment can solve great national problems. I do not believe that the indiscriminate kindness we may seem to be able to show to some thousands, or hundreds of thousands, or millions, of European and Asiatic immigrants can in any conceivable way counterbalance the harm that these people may do our race if large numbers of them are mentally and physically unfit.

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[1] This paper was read before the thirteenth annual meeting of the American Genetic Association, in New York City, Dec. 27, 1916. It has been considerably modified since the passage of the Burnett Act.

[2] This is true only up to February 1 of the present year. Since the beginning of the new German submarine campaign, immigration has fallen off much more.

TESTING MALE IMMIGRANTS AT ELLIS ISLAND

In 1914, the last year of heavy immigration, 6,537 aliens were excluded because of physical or mental defect which was thought likely to make them become public charges. Half of these were suffering from some loathsome or contagous disease, while 1,247 were mentally defective. Trachoma, a contagious disease of the eyes, is the commonest cause for exclusion, and four-fifths of those who were excluded for physical defects were suffering from it. Since the outbreak of the war, the number of immigrants arriving has much decreased, and the examiners have therefore had time to inspect them more thoroughly, with the result that a larger percentage than usual of defectives has been detected. Photograph copyright by Underwood and Underwood. (Fig. 1.)

Indiscriminate hospitality to immigrants is a supremely short-sighted, selfish, ungenerous, un-American policy. It may give us, for the moment, a comfortable feeling that we are providing a "refuge for the oppressed." But that is as narrow an attitude as the one which indiscriminately gives alms to any person on the street who asks for money. Such "charity" may, truly, produce a warm feeling of personal generosity in the giver himself. But alms-giving of this sort is likely to do more harm than good. It is

likely to pauperize him who receives, and it inevitably increases the burden of pauperism and of inefficiency which future generations will have to bear. It is in the highest degree ungenerous for us, who are the custodians of the future heritage of our race, to permit to land on our shores mental and physical defectives, who, themselves and through their descendants, will lower the mental and physical standards of our own people, and will tremendously increase all our future problems of public and private philanthropy. We have no right to saddle any additional burdens upon the already overburdened coming generations of Americans. It is in the highest degree un-American for us to permit any such influx of alien immigrants as will make the process of assimilation and of amalgamation of our foreign population any more difficult than it already is. We all know that the situation is discouraging enough already. I am satisfied that our policy of admitting freely practically all who have wished to come, and of encouraging them in every way to come, has not helped the introduction of political, and social, and economic, and educational reforms abroad, but has rather delayed the progress of these very movements, in which we, as Americans, are so vitally interested. Had the millions of European immigrants who have come to this country within the last quarter-century remained at home, they would have insisted on the introduction of reforms in their own countries which have been delayed, decade after decade, because the discontent of Europe found a safety-valve by flying to America. We are constantly told by our idealists that the "cream" and the "pick" of Europe has been coming here because it is discontented at home; because it wants political and religious and economic liberty; because it wants education, and better living conditions, and democratic institutions. Have we, in any way, helped the progress of all these reforms by keeping the safety-valve open? By allowing and by encouraging to come here, after the war, the discontented millions of Europe and Asia, are we likely to hasten, or to delay, the coming of political and religious and social reforms in Armenia, in Syria, in Hungary, in Poland, in Russia, in Turkey? As I see it, and my conviction is perfectly clear on this point, our duty as Americans, interested in the world-wide progress of education, of religious liberty, of democratic institutions, is to help the discontented millions of Europe and of Asia to stay in their own countries, and to work out there, for themselves, what our own forefathers worked out here for us. That would be the greatest contribution we could make to the progress and preservation of American ideals.

THE EUGENIC PROBLEM

We are, however, not here concerned with the economic or with the political aspects of immigration. Our problem has to do with the mental and physical condition of those who are coming here, and especially of those who will come when the war is over. Our immediate, paramount interest is eugenic.

The marked reduction in the numbers of our alien arrivals since the war began has had both direct and indirect consequences of eugenic importance. However large may have been the proportion of mentally and physically undesirable aliens who have been admitted to the United States since the war began, it is certain that the total number of defectives who have been landed has been smaller than during a "rush year." This has lessened the supply of new cases of mental and physical disability for us to take care of. It has, temporarily at least, diminished some of the pressure upon our institutions. It has enabled us to do better work for those who are already here. With the pressure which comes from the usual enormous inflow of aliens somewhat relieved, all our problems of public and private philanthropy have been immensely simplified. Our financial burdens have been lightened. We have, for the time being, had a little breathing-space. What a feeling of relief all of us would experience if we could be sure that no more

INSPECTING A GROUP OF FEMALE IMMIGRANTS

Hitherto the exclusion of undesirable immigrants has been difficult, because the force of examiners was not large enough to meet the rush of arrivals in the spring, and because the law omitted certain classes who should have been kept out. The new immigration act, passed by Congress in February, increases the inspecting staff and makes important new provisions for excluding those whose presence in the United States would be dysgenic. It also contains provisions which ensure greater consideration and safety for the individual immigrant. Photograph copyright by Underwood and Underwood. (Fig. 2.)

insane, or feeble-minded, or diseased, or physically defective aliens would ever again be allowed to land at our ports. How cheerfully and how hopefully we could then look forward to real progress in our care of the defective classes already in our midst, and waiting to be born of those who are now here.

The last report of the New York Children's Aid Society has very clearly pointed out the good that has resulted in its work from the temporary reduction in the numbers of immigrants. "We are encouraged in our fight against inefficiency and ignorance," it said, "because we feel that the immigrants are really being educated through their children. If the uplift forces in New York could count on a continuance of the present blockade of immigration, the worst of the evils of poverty could undoubtedly be ended in a few years."

This is no unduly optimistic view. A similar statement might with equal truth be made by educational and philanthropic organizations in all cities into which, in normal times, a large

stream of immigration flows. All our charitable organizations have had their burdens lightened by the wide prevalence of "prosperity." With the reduction in the inflow of unskilled foreign labor, and the extraordinary demand for labor which has existed in many industries as a result of the war, there is now very little unemployment; wages are high; the standard of living of our working classes is rising. The line is now clearly drawn between unrestricted immigration, which means low wages, cheap labor, and un-American standards of living; and a reasonable selection of immigration, which means better wages, more intelligent labor, and American standards of living.

Fortunately, a better selection will henceforth be made.

PASSAGE OF NEW LAW

Early in February both houses of Congress passed, by more than a two-thirds majority, and over the President's veto, a new immigration act embodying several eugenic provisions which had been heartily endorsed by the Immigration Committee of the American Genetic Association. It is a very great satisfaction to be able to report the final enactment of this legislation, which is of the greatest importance for the future mental and physical well-being of our people.

Among other things, the new act provides that every immigrant must be able to read 30 or 40 words in his own language; but an exception is made for those who on account of race or religious persecution have had no opportunity to get an education; and admitted aliens may also bring in relatives, even if the latter cannot read.

This literacy test has attracted so much attention that it is sometimes supposed to be the principal feature of the law. As a fact, it occupies only one or two of more than 60 pages of the act as it was printed in customary form for the use of Congress. With the many exceptions which are made in its application, this provision seems to the writer a rather unimportant feature. The new law is, in its essentials, a eugenic measure—perhaps the most comprehensive and satisfactory ever passed by Congress. The main features of it were summarized in the last report of the Immigration Committee of this Association,[3] but it may be useful to mention them again.

To the classes formerly excluded the bill adds persons of *constitutional psychopathic inferiority* and persons with *chronic alcoholism*. The desirability of keeping out the latter is obvious. The former phrase is a technical one which designates persons who may be quite sane in a certain environment, but who are unable to readjust themselves to a change in environment. They may not be defective intellectually, but are defective emotionally. Hospitals for the insane, on the Atlantic seaboard, have been filling up with immigrants in recent years, partly because the change to a new and more strenuous environment was too much for some aliens; and it is believed that this new provision will permit the exclusion of many who would become insane soon after arrival, even though they are not actively insane at the time of examination.

SAFEGUARDS FOR ALIEN

The new act excludes *vagrants*, and persons afflicted with *tuberculosis* in any form, and attempts to prevent the embarkation of these and other excluded classes by imposing a heavier fine on the steamship company if they are brought. This should lead to a more thorough examination at the point of departure, and prevent hardship on aliens who make the trans-

[3] War, Immigration, Eugenics (Third Report of the Committee on Immigration, A. G. A.), in the JOURNAL OF HEREDITY, Vol. viii, pp. 243–248, June, 1916. See also:

Second Report of the Committee on Immigration, JOURNAL OF HEREDITY, Vol. v, pp. 297–300, 1914.

First Report of the Committee on Immigration, *American Breeders' Magazine*, Vol. iii, pp. 249–255, 1912; and

Eugenic Immigration, by Robert De C. Ward; *American Breeders' Magazine*, Vol. iv, pp. 96–102, 1913.

Atlantic voyage only to be rejected and sent home.

The new act provides for much more thorough medical examination of immigrants, especially with reference to mental diseases, by providing additional inspectors and giving them additional facilities.

At present, if an immigrant is found, within three years of his arrival, to belong to one of the excluded classes, he may be deported, even though he passed the first examination at Ellis Island successfully. The new act increases to five years the length of time during which such deportation may take place. This will enable us to get rid of many undesirable aliens, for whose defects we are not responsible, and who, if they stayed here, would be a burden on the United States and in too many cases would establish lines of defective and delinquent offspring.

The new law strengthens the provisions regarding the "white slave" traffic; compels steamship companies when deporting aliens to give such aliens as good quarters as those for which they paid on the voyage to this country; makes possible the expulsion from the United States of alien anarchists and criminals, even when they have become such after arrival here; and in many other ways provides for the welfare of the alien as well as for that of the United States.

In general, it will be seen that the new law makes no radical changes in practice; it only strengthens those practices which have been found desirable, giving additional protection to both the United States and to the individual alien. Such a revision of the immigration laws has long been recognized by every expert as an imperative necessity. The American Genetic Association, as well as every one who has at heart the eugenic welfare of the United States, has good reason for satisfaction in the final enactment into law of a measure which cannot fail to result in a marked improvement in the mental and physical qualities of future alien immigrants.

Eugenics Too Broadly Interpreted

THE EUGENIC MARRIAGE, A Personal Guide to the New Science of Better Living and Better Babies, by W. Grant Hague, M.D. Four vols., 656 pp., with illustrations. New York: The Review of Reviews Company, 1916.

Dr. Hague's book is ill named, for it deals with home-making and mothercraft primarily, rather than with eugenics—four chapters, for instance, are devoted to the evils of patent medicines. Eugenics, in the sense that the word is used by this journal, receives rather scant treatment, and what is said is often marred by exaggeration or error. Hague's statement: "Any condition that fundamentally means race-deterioration must be rendered intolerable. The prevalent dancing craze is an anti-eugenic institution, as is the popularity of the delicatessen store," is hardly an extreme example of the comprehensiveness and indiscriminateness of his idea of eugenics. He has a good deal to say about sex hygiene, but it is unreliable and likely to do more harm than good. His voluminous discussion of child-birth, the care of children, and the relations of husband and wife, appears to be much sounder, so far as the reviewer is qualified to judge. It is to be regretted that this part of the book could not have been published alone, and the discussion of so-called eugenics omitted, for despite the author's enthusiasm and sincerity, he does not possess an understanding of eugenics.

Progress of Reindeer Industry in Alaska

The industry of reindeer breeding, which was introduced among the natives of Alaska by the U. S. Bureau of Education, is making steady progress, according to the annual report for 1916. There are now about 75,000 reindeer in the country, and shipments of meat are regularly made to Seattle. This industry was described by Levi Chubbuck in the JOURNAL OF HEREDITY, v, 149–154.

THE MIND OF THE NEGRO

Psychological Tests Indicate That Black and White Races Are Equal in Lower Mental Functions but Not in the Higher Ones—Industrial Education Therefore Better Adapted to the Negro Race than Literary Education—Possibility of Production of Eminent Men from the Negroes and Mulattoes in America

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THAT the mental ability of the negro is measurably different from that of the white race is the conclusion of George Oscar Ferguson, Jr., who applied tests to 486 white pupils and 421 colored pupils in the schools of Richmond, Fredericksburg, and Newport News, Va.

Numerous exact experiments have shown that "in the so-called lower traits there is no great difference between the negro and the white. In motor capacity there is probably no appreciable racial difference. In sense capacity, in perceptive and discriminative ability, there is likewise a practical equality." Mr. Ferguson's investigation[1] was therefore planned "primarily with a view to ascertaining racial differences in the higher rather than the lower intellectual capacities."

"It is in the higher capacities that men are supposed to differ most," he points out. "And it is these capacities that are of the greatest influence in determining their relative achievement. The investigations previously made and the views previously held indicate that there are no considerable group differences in sensation, in motor control, in native retentiveness. The differences to which evidence has pointed have been, on the side of intellect as opposed to feeling, in such abilities as those included under the terms constructive imagination, the apprehension of meaning, reasoning power. These latter traits divide mankind into the able and the mediocre, the brilliant and the dull, and they determine the progress of civilization more directly than do the simple and fundamental powers which man has in common with the lower animals."

Evidence is presented to show that the tests really measured racial ability, and not merely differences in training or the result of different home environments. Ferguson thinks that his tests confirmed those previously made, showing "that the average performance of the colored population of this country, in such intellectual work as that represented by the tests of higher capacity, appears to be only about three-fourths as efficient as the performance of white persons of the same amount of training. It is probable, indeed, that this estimate is too high rather than too low."

EFFECT OF WHITE BLOOD

Ferguson further divided the colored pupils in accordance with their percentage of white blood (as shown by skin color and other physical traits). Classifying the results on this basis leads him to say:

"While the intellectual performance of the general colored population is approximately 75% as efficient as that of whites, this figure is not true for different classes of negroes. It is probably correct to say that pure negroes, negroes three-fourths pure, mulattoes and quadroons have, roughly, 60, 70, 80, and 90%, respectively, of white intellectual efficiency. If it were possible to distinguish these four classes of negroes so accurately as to avoid overlapping, it is probable that the differences revealed by tests would be greater rather than less than those indicated by the figures."

The significance of these findings on the work of negro education seems to Ferguson to be important. He says:

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[1] The Psychology of the Negro, an experimental study by George Oscar Ferguson, Jr. Columbia University Contributions to Philosophy and Psychology, Vol. xxv, Archives of Psychology, No. 36, April, 1916. New York (Sub-station 84). The Science Press. Price, $1.25. Pp.138.

"The negro's intellectual deficiency is registered in the retardation percentages of the schools as well as in mental tests. And in view of all the evidence it does not seem possible to raise the scholastic attainment of the negro to an equality with that of the white. It is probable that no expenditure of time and money would accomplish this end, since education cannot create mental power, but can only develop that which is innate.

"The movement toward industrial education for the negro finds sanction in the studies of his psychology. Without great ability in the processes of abstract thought, the negro is yet very capable in the sensory and motor powers which are involved in manual work. And economy would indicate that training should be concentrated upon those capacities which promise the best return for the educative effort expended. Social conditions, of course, have been the main incentive to the growth of industrial education among negroes, and in themselves they are sufficient reason for emphasizing an intensely practical training. But the mental nature of the negro gives reason for believing that this sort of education is the only one which will avoid great waste.

"But while it thus appears that for the colored population as a whole a manual is more practicable than a literary education, it must not be overlooked that there are individual colored persons of great ability. The widely held doctrine that the negro's mental growth comes to a comparative standstill at adolescence does not find corroboration in the results of tests. . . . So far as has been demonstrated, the negro's intellectual development proceeds as rapidly after puberty as does that of the white."

LEADERS ARE MULATTOES

Although mulattoes make up only about one-fourth of the colored population of the United States, their superior ability, due to the possession of white blood, and shown in the tests above mentioned, leads one to expect that of colored people who show ability, more will be mulattoes than full-blooded negroes. This is, in fact, exactly the situation that a survey of eminent colored persons shows. Ferguson makes some interesting calculations, based on Galton's law of deviation from the average, as to the number of eminent people to be expected in the population of the United States. Considering only white men, pure negro men, and mulatto men, he finds that "if all three classes have the same ability, there will be 4,464 eminent white men, 397 eminent pure negroes and 99 eminent mulattoes," the standard of eminence being that laid down by Galton, viz., attainment so great that it is reached by only one man in 4,300.

"But if we assume that pure negroes average 75% of white ability and that mulattoes average 87.5% of white ability, we find the following situation growing out of the law of deviation from an average. In a million of each class of men there will be 248 whites, 15 mulattoes, and 1 pure negro who will attain the above-mentioned degree of eminence. Considering the number of these three classes in the total population, there will be 4,464 eminent whites, 6 eminent mulattoes and 2 eminent negroes in the United States.

"These figures are suggestive. If we take it that there are 4,464 eminent white men in America, there are certainly not 397 pure negroes and 99 mulattoes of the same degree of eminence. There are more nearly 6 mulattoes and 2 pure negroes to 4,464 eminent whites. Definite figures are not obtainable, but such lists of men of achievement as have been compiled accord with the latter set of figures far more closely than with the former."

This method of deduction, therefore, seems to Ferguson to confirm his tests, and those of other psychologists (of whose work he gives a valuable review), and to indicate that "the white type has attained a higher level of development, based upon the common elementary capacities, which the negro has not reached to the same degree;" that the difference is germinal and cannot be modified by education or any environmental changes.

HOW DO YOU CLASP YOUR HANDS?

If the hands be clasped naturally, with fingers alternating as shown in the above illustration, most people will put the same thumb—either that of the right or that of the left hand—uppermost every time.

Frank E. Lutz showed (*American Naturalist*, xlii) that the position assumed depends largely on heredity. When both parents put the right thumb uppermost, about three-fourths of the children were found to do the same. When both parents put the left thumb uppermost, about three-fifths of the children did the same. No definite ratios could be found from the various kinds of matings.

Apparently the manner of clasping the hands has no connection with one's right-handedness or left-handedness. It can hardly be due to imitation, for the trait is such a slight one that most people have not noticed it before their attention is called to it. Furthermore, babies are found almost always to clasp the hands in the same way every time.

The trait is a good illustration of the almost incredible minuteness with which heredity enters into a man's makeup. Photograph by John Howard Paine. (Fig. 3.)

THE INDIANA SURVEY

Examination of Two Counties Shows Presence of Fifteen Mental Defectives Per 1,000 Population—No Provision Made for Most of Them—Many of Them Not Even Recognized[1]

A. H. Estabrook, *Eugenics Record Office*

ALTHOUGH the fact of mental defectiveness in the population has attracted much attention, during the last decade, there are yet few data available to show the proportion of defectives in an unselected population—an ordinary, intelligent, prosperous, progressive community. In August, 1915, the governor of Indiana appointed a committee to study the problem of mental defectiveness in Indiana, and this committee planned a survey of two entire counties, for the purpose of determining what percentage of the population was anti-social by reason of mental defectiveness. The survey was entrusted to the writer and two field-workers from the Eugenics Record Office, Miss Edith S. Atwood and Miss Clara P. Pond. It was determined to limit the survey to the feeble-minded, insane and epileptic.

The two counties, shortly to be described, are designated in the report as "A" county and "B" county. They were studied by inquiries, consultations and visits to physicians, school authorities, township trustees, boards of children's guardians, institution heads and social betterment agencies. Practically every person who has been studied in this enumeration of mental defectives, has been visited either in his own home, at school or at business. In many cases the investigators have talked with parents and have advised as to the future care and training of some of the defective children. The three investigators spent about three and one-half months each in the field study. The data gathered are accurate and it is felt that the field has been fully covered, although a few cases of mental defect may not have come to the attention of the investigators. About 30 to 40% of the individuals reported to the investigators as defective have been classed by them as either doubtful, borderline cases or normal, and, therefore, have not been included in the totals presented.

A COUNTY

The northern half of *A* county is composed of fertile land, the southern part is hilly, rather rough and unproductive and less accessible. A narrow strip along the western border is composed of fertile land. There is one city of some size situated about the center of the county at the southern edge of the more fertile northern part already mentioned. The county was settled early in the history of Indiana mainly by immigration from Kentucky.

B COUNTY

B county is situated in a very fertile section of the State. One city of some size is the county seat and here there is much manufacturing taking place. This county was settled by immigration from Ohio and the eastern States. There are, at present, few foreign born people in *B* county. Statistical tables showing the results of the investigation in *A* and *B* counties follows:

	A co.	*B co.*
Epileptics in institutions......	6	13
Epileptics outside of institutions......................	31	52
	37	65

[1] Read before the thirteenth annual meeting of the American Genetic Association, New York City, December 27, 1916. The report of this survey, and some related material, was published by the Board of State Charities in pamphlet form in November, 1916.

	A co.	*B co.*
Insane in institutions	49	57
Insane outside of institutions	29	24
	78	81
Feeble-minded in institutions	31	33
Feeble-minded outside of institutions	254	219
	285	252

Total number of defectives in two counties (subtracting duplications, where one person showed two of the defects studied: 4 in *A* county and 17 in *B* county):

In institutions	179
Not in institutions	598
	777

These figures get significance only from the total population of the counties. It is to be noted, then, that in *A* county the epileptics are 1.8 per 1,000 of the general population and in *B* county 1.9 per 1,000.

The insane are 3.8 per 1,000 in *A* county and 2.4 in *B* county.

The feeble-minded represent 13.9 per 1,000 population in *A* county and 7.6 in *B* county.

Total defectives, subtracting duplications, are 19 per 1,000 population in *A* county and 11.5 in *B* county.

As the above facts are the significant ones, they will bear further discussion.

EPILEPTICS

The ratio of 1.8 epileptics per 1,000 population in *A* county is so close to that of 1.9 in *B* county, that it is probable that the figure of 1.85 epileptics in every 1,000 people indicates the true amount of epilepsy in Indiana. Some of these epileptic cases show insanity and also feeble-mindedness, and a small proportion are now in some institution. In *A* county the investigators estimated that 14 epileptics, 8 males and 6 females, are in such condition physically or mentally as to need some sort of custodial care. In *B* county 15 epileptics were found in need of and without care. Assuming that the ratio of 1.85 per 1,000 population is true for the whole State, there would be 4,995 epileptics in the State. (Population of Indiana, 1910 census, 2,700,000.) The number in the State needing institutional care could only be found out by a complete survey, but an estimate would place it at about 1,000.

INSANE

The insane from *A* county numbered 78, or 1 to 263 of the population. This figure is very close to the ratio of 1 to 279 found in Massachusetts in 1909; 1 to 282 in England in 1907 and 1 to 300 in New York in 1907. In *B* county there was found only one insane person to every 408 of the population, a ratio much less than in *A* county. No explanation for this difference is apparent. It is difficult to estimate the number of insane in the State from these two ratios and this difference shows that further information on the mental condition of the people of the State is necessary before the problem of the mental defective is fully known.

Assuming that the *A* county ratio holds for the whole State, there would be 10,000 insane in the State while the *B* county ratio of 1 to 408 would call for 6,617 insane in the State.

Thirteen insane in *A* county and 13 in *B* county are now in need of institutional care, a total of 26 in the two counties. The population of *A* and *B* counties together is about one-fiftieth of that of the whole State and this ratio carried out would indicate that there are about 1,300 insane in the State now needing and without institutional care.

FEEBLE-MINDED

Until within a few years the problem of the feeble-minded has been less clearly recognized and understood by either the medical man or the social worker. The general public had no idea of its extent. It really is very large.

The methods used in determining the mentality of those tabulated above have been the regular mental tests, the individual school ability and power to learn, and also the reaction to the environment which is the real and final test of anyone's mental capacity.

We found 285 feeble-minded persons in *A* county, or 13.9 per 1,000 of the

population. In presenting this result the investigators wish to call attention to the fact that many individuals are classed here as feeble-minded who are not recognized by the general public as defectives. Some of these are called "dull" or "stupid" or "peculiar" or "crazy" or "eccentric." Mental defectiveness is the cause of the atypical behavior of those of this group who are tabulated. In other cases the deficiency is only too apparent. The southern part of *A* county, hilly, rugged and unproductive, has sheltered for many years a class of people listless and lazy and indifferent. The people have intermarried because of the geographical features of the county about them, and have intermingled little with the more intelligent and mentally active people of the rich lands at the north of the county. There is little enforcement of the law respecting marriage. The schools do their best, but the trained and highly capable school teacher will not remain in "these hills" when he or she can secure better wages and living conditions in the villages and cities nearby, and so the young, untrained teacher occupies the position where one older in experience should be placed to bring out the most and best there is in each scholar. Children grow up in homes away from the refining influences of the church and society and have no elevating example set before them. As a result, the more efficient and capable of the population leave this unproductive and unattractive region for the rich lands and cities of industry, and those weaker mentally remain to perpetuate their kind in a place where competition and strife are at a minimum. This part of *A* county has produced a large part of the defectives in that county. The northern part of the county has its mental defectives, too, but they are not as numerous per unit of population as in the southern part. Many of these feeble-minded are in good homes well cared for and the parents, or those in charge, realize that permanent care and training of these defectives is necessary, and are giving it. There are also many defectives who are old and in general harmless, and many feeble-minded women above the child-bearing age. The rest of the feeble-minded, the women of child-bearing age, the defective children who need care and training, and the men of all ages who are a menace to the community from sexual or other reasons, are classed as "needing institutional care at once."

MANY NEED CARE

In *A* county 169 feeble-minded are in need of custodial care at once to care properly for the social welfare of the defectives in *A* county and to stop, in a measure, the increase of feeble-mindedness.

In *B* county 252 feeble-minded persons were found, or 7.6 per 1,000 of the population. *B* county, as mentioned, is, in general, flat and has very fertile land throughout. This uniformly good land, rather level except for the valleys made by the three rivers which cross the county, has determined to a great extent the character of the people who live in the region. The commonly inefficient, lazy, degenerate families cannot gather in any large groups, as in the southern part of *A* county, because of the competition of the more energetic, normal citizens for the control of the land. The more inefficient are soon pushed off the fertile land by competition of the industrious ones and, as there are no comparatively non-arable acres, the more shiftless and inefficient ones cannot exist so easily in the community. It is interesting to note that outside of the villages and cities, practically all the degenerate families in *B* county live along the bluffs or banks of the rivers. A few families, all of whose members are feeble-minded, live on farms which they inherited from their ancestors; but it is interesting to see that as time goes on, these farms are becoming smaller and smaller as the neighbors push in on them and the feeble-minded folk are obliged to sell off parts of the farm for self-preservation. The rest of the defectives in *B* county were found in the villages and cities where the competition was not so keen. Few extended family histories of the feeble-minded could

be worked out in *B* county for this reason. This same condition of affairs has excluded much intermarriage among defective families, because of the fact that these families are not segregated into any definite locality. As a result, there is not as much association of the feeble-minded with each other, and accordingly there are not so many cases of the defectives needing custodial care. In *B* county 76 feeble-minded were found needing institutional care, according to the definition just above.

FIGURES FOR WHOLE STATE

If the figures obtained in these two counties hold good for the rest of the State of Indiana, it must be supposed that there are about 5,000 epileptics in the State, only 305 of whom are now in the State village for epileptics. Of course, many of these persons are not anti-social in their conduct, but may be leading useful lives. But even if their labor is of benefit to the State, it is not likely that their reproduction will be.

A fair estimate indicates that there are between 7,000 and 8,000 insane in the State. The great majority of these, over 5,300, are now cared for in State hospitals for the insane, besides 400 patients on furlough from and still under supervision of the hospitals. In addition, there are 278 insane in the Hospital for Insane Criminals at Michigan City.

The problem of the defective becomes most apparent when the figure for feeble-mindedness is considered. This figure lies probably somewhere between 7.6 and 13.9 persons per 1,000 of the population. Inasmuch as almost twice the amount of feeble-mindedness was found in *A* as in *B* county, it is impossible to attempt to calculate the number of feeble-minded in the State. A fair estimate will place it at about 20,000, including all grades. It is estimated that 6,000 of these should be under State custodial care, and only 1,350 are now receiving it.

The total number of epileptic, insane and feeble-minded in Indiana, then, may be assumed to be about 32,000, or 1.2% or 12 to 1,000 of the general population. It is evident from these data that while more information is necessary in order to know exactly the problem of the mental defective in this State, yet there can be no doubt that the State should make immediate provision for many more of its defectives than it is now making.

It is interesting to extend these calculations to the entire United States, even though little weight can be attached to such speculations. If the ratios found in these two counties held good for the entire nation, there would be more than 1,000,000 defectives (epileptic, insane, or feeble-minded) in the country. Large as this figure appears, it is not much higher than some of the most reliable estimates that have been made by students of the problem.

In conclusion, the survey here reported is believed to be of interest because it shows the approximate amount of mental defectiveness of three types in an ordinary, unselected, American population. The number of defectives is great enough to be a serious drag on the community at present, and to threaten, through reproduction, to become a much greater one in the future. A large part of these defectives are receiving no supervision—they are often not even recognized. Appropriate measures can and should be taken to prevent these persons from reproducing their kind.

Effect of Alcohol on Offspring

Whether the offspring of alcoholized rats are inferior to those from normal parents is being tested by E. C. MacDowell at the Carnegie Institution Laboratory, Cold Spring Harbor, L. I. A summary of the study is given in the institution's annual report for 1916. He reports that "breathing the fumes of alcohol for 90 minutes a day for 100 days does not cause rats to produce young with any sort of physical abnormalties that can be observed." Mental tests of the young have given contradictory results.

NATURAL DWARFING

Severe Climate and Lack of Food Produce Remarkable Differences in Plants—Effects Probably Not Hereditary—Dwarfed Arbor-Vitae

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WHEN plants grow in poor soil, where they do not get enough food, they are likely to be dwarfed. Some writers call this dwarfing "nanism;" others reserve that name for the rarer form of dwarfing which is apparently due to some abnormality in the mechanism of heredity, and which is exemplified by *Oenothera nanella*, a dwarf mutation from Lamarck's Evening Primrose. This dwarf comes true to seed, as do most other mutant dwarfs.

Most of the dwarf plants found in nature, however, are small only because of lack of nourishment. An example is the mesquite (*Prosopis juliflora*) of the southwestern States, which is famed as an indicator of sources of water supply, because of the water seeking propensities of its roots. In favorable locations the mesquite is an average tree in size, but it becomes a gnarled and scraggy shrub when growing in an environment which contains insufficient food and moisture.

The art of the oriental gardeners in producing the spectacular dwarf "Trees of Life" is dependent upon the starvation of the entire plant. Spruces, oaks, orange, arbor-vitae and other trees have been made to bear fruit when less than two feet in height. These pygmy products formerly sold for fabulous prices, hundreds of dollars sometimes being paid for a single perfect specimen. Professor Sorauer, of Berlin, mentions a dwarf specimen of *Thuja obtusa* which cost $87.50, the value evidently being so placed within recent years. These dwarf trees are in great favor throughout China, where it is said every house of any pretension whatever exhibits one or more specimens. The dwarfing tendency, according to Staunton, is perpetuated when the plants are propagated vegetatively,[1] but conclusive experimental data upon this point do not seem to be available.

American gardeners have duplicated the products of the Japanese and Chinese by simply starving the plants in small pots and severely pruning the root system. Frequent transplanting is necessary in order to produce the best results. The crown is kept proportionately cut back in order that the tree may not be injured by the loss of too much water in transpiration. The limiting of the soil content is perhaps the biggest factor in the production of dwarfs.

The general principles of dwarfing as herein stated were confirmed in nature in a very interesting manner by plants recently collected by the writer. Growing in almost soilless rock crevices on the barren shores of Lake Superior, a pygmy forest of severely dwarfed spruce, *Picea mariana*, and arbor-vitae, *Thuja occidentalis*, was discovered. Eighteen annual rings were counted in a spruce slightly more than a foot high, and fifty-three rings were revealed by the compound microscope in the trunk of an arbor-vitae a foot tall. These plants were dwarfed probably by both the lack of water and of necessary minerals.

The experiments of Moller with a wild grass, *Bromus mollis*, indicate that this form of nanism is not hereditary. He produced progeny of large size from the seed of dwarf plants. However, under equal vegetative conditions, he found that seed from normal plants produced more vigorous specimens than did seed from dwarf plants.

[1] Manual of Plant Diseases—Sorauer. Vol. 1, part 11, p. 142.

TWO DWARF SPECIMENS OF ARBOR VITAE

The specimen at the left, which is only six inches high, was growing in a crevice of rock. It is a mature tree, as is proved by the fact that it is bearing two fruits, which can be seen on a square of black paper which was put in for a background. The one at the right, which is not as high as an ordinary compound microscope, is over 50 years old; the notch at the base shows where sections were removed to make possible a count of the annual rings. The dwarfness of these specimens is not due to heredity, but merely to the fact that they have never had enough food. (Fig. 4.)

Nanism due to scarcity of nutritive substances, according to Sorauer, affects the number of blossoms in flowering plants, the number of flowers being considerably reduced. Instead of a cluster or a head, there is often only a single blossom. He further states that, where a greater number of blossoms are formed, single seeds develop which can germinate.

The same is true among the coniferous plants as indicated by the natural dwarfed trees found by the writer. Several trees were found which bore fruit, one of which is here illustrated, but the number of fruits formed on each tree was small. On one of the specimens here pictured, only two cones were produced. This tree is remarkable in that, though only about six inches tall, the plant was an adult, as indicated by the fruit. The annual rings in this specimen were not counted.

The material here described was found upon the rocks close to the water's edge on the shore of Lake Superior on the Keneenaw Peninsula, Michigan, about two miles from Norland. The ecological phenomenon called Krummholz was also frequent in the region.

A NORMAL ARBOR VITAE

Under ordinary conditions, with fairly good soil and a sufficient supply of food and water, the arbor vitae becomes a large, well-proportioned tree, like the one shown above. This one is probably no older than the foot-high specimen shown in the preceding photograph. (Fig. 5.)

TO SOLVE A SHORTHORN PARADOX

CHAMPION Shorthorn bulls have onbreeding power; they commonly transmit their good qualities to their progeny. But if all the champion Shorthorn cows for many years back are examined, it is found that only one of them is the daughter of a prize winner. In other words, prize Shorthorn cows seem as a rule to produce no prize winning offspring.

This situation, which seems almost paradoxical to a student of heredity, might be easily explained by supposing that the qualifications demanded of a prize winning Shorthorn cow are such as are incompatible with the production of the best calves. And investigation suggests that this explanation is correct. In America the Scotch or beef type of Shorthorn has for many years been fashionable, and judges demand that both bulls and cows show as beefy a comformation as possible. Now a cow cannot excel as a beef animal and a milk animal at the same time, and as the judges demand beef, they consistently penalize any cow of the milking type that appears in the show ring. But a cow with little milk might be expected to have inferior calves, and investigation of a number of herds showed that, as a fact all the best calves came from heavy milking cows.

It appears, then, that Shorthorn judges are insisting upon a type of cow which is not the best producer, from a breeder's standpoint.

If heavy milking cows of beef strains were selected, it ought to be possible to have the breed producing not only good beef steers, but also milking cows —at least with more than enough milk to nourish their calves properly.

To test this proposition, a 20-year breeding experiment has been started at Manhattan, Kansas, by coöperation of the Kansas State Agricultural College and the Bureau of Animal Industry. Twenty cows which had produced one or more outstanding beef calves, far above the average of the breed, but which also showed pronounced milking tendencies, were selected, and will be mated with bulls of pronounced show-ring or beef type. Any cows which fail to produce good calves will be eliminated and others substituted, and it is hoped after some years to be able to form an exact opinion as to what type of female is best qualified to produce winning calves in a beef breed.

Many experienced breeders are opposed to the extent to which demand for the Scotch or exclusively beef type of Shorthorn has been carried, and it seems likely that this experiment will aid in the return toward a standard of breed in which the cows will, at least, not be required to sacrifice milking function.

A Non-Broody Strain of Rhode Island Red Fowls

It is well known that some races of fowl, *e.g.*, the Leghorns, rarely become broody, while the Asiatic breeds have a strong tendency to incubate as soon as they have laid a number of eggs. For the modern breeder, supplied with artificial incubators, broodiness in hens means considerable loss, and it is therefore desirable to eliminate broodiness from all breeds as far as possible. H. D. Goodale, of the Massachusetts Experiment Station, who presented a paper on the subject at the last meeting of the American Society of Zoologists, stated that a non-broody strain of Rhode Island Red, one of the most popular of the general purpose breeds, has probably already been established. What a change this means will be realized from the fact that 95% of the hens go broody before July 1 in their pullet year.

BREEDING FOR ATROPINE

Great Variation in Alkaloidal Content of Belladonna Plants Promises Results to Selection—External Characters of Plant Seem to Give a Clue to Its Chemical Content

L. Wayne Arny

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THE high prices paid for crude drugs, brought about by the abnormal economic conditions of the last few years, have stimulated a wide and popular interest in the cultivation of the plants yielding these products. Unfortunately for the crude drug industry, a great part of this interest has been aroused merely from a view toward financial investment and the real issues at hand have been generally overlooked.

There is no question but that America must grow a large part of her drug supply in the future since the drug importations are yearly becoming less dependable. The adulterations which are being made by collectors of crude drugs render the purchase of these plants upon the open markets extremely unsatisfactory and if the American manufacturer of pharmaceuticals is to produce articles of high grade, he must either grow his own vegetable drugs or obtain them from someone who he knows is growing them honestly.

Certain economic facts, however, must be considered. Competition with European peasant labor greatly reduces the chances of financial profit from American production, and unless some step can be taken to produce drugs superior to those of European origin, no hope can be found for such an industry in America upon a purely financial basis. It is probable, however, that such improvement can be brought about, and the competition will be changed from quantity against quantity to quality against quantity. Stating the case in a more simple way it may be said that financial success in the cultivation of drug plants depends upon the possibility of increasing the alkaloid content of these plants by plant breeding methods.

The object of this paper is to point out to breeders who are interested in this field of work the opportunity which these plants offer for selective methods of improvement. The resulting improvement from research work in this direction not only will afford the satisfaction which is coincident with accomplishment, but will provide raw materials of uniform and high quality to the exacting professions of medicine and pharmacy. This surely then is a worthy field for experimental effort. It at once becomes evident that the work of increasing alkaloids in a plant differs from that of increasing size, changing color or form. The investigator is dealing with unseen characters.

LITTLE HYBRIDIZATION DONE

Hybridizing drug plants has been attempted by several workers and under varying conditions but in general little result has been gotten from this method. There may be exceptions to this statement, such as cinchona;[1] but especially with plants of the temperate zone, the great majority of crossing experiments have resulted only in a chaotic jumble of characters without meaning. This is to be expected when we keep in mind the class of plants with which we are dealing.

The most serious effort then must

[1] The South American cinchona tree, from the bark of which quinine is secured, has been improved by breeders in Java, who have selected the best of many natural hybrids, and propagated them asexually. This is usually referred to as the only drug plant which has been improved through hybridizing; but so far as I am aware, there is no record of really scientific breeding having been done with it.

be through selective methods, but here again certain difficulties at once arise. Since the characters with which we are working are unseen, the number of individuals that can be placed under observation is therefore limited, and in turn the chances of success are proportionately reduced.

In establishing a system of selection of belladonna[2] (*Atropa belladonna*) at the Mulford Drug Gardens, the effort was made to overcome this difficulty by establishing a correlation between some apparent physical character and alkaloidal content. If such a correlation could be demonstrated, the advantage of observing thousands of individuals rather than hundreds would be at hand.

The breeding plot contained 500 individuals which were chosen from a lot of several thousand seedlings. The seed from which these plants were grown had been imported from Germany and no previous history of them was known. They were sown in the greenhouse in January and potted off in the usual manner. Those used for the breeding plot were chosen only because of uniform size and apparent vigor. Some of the features of the plant were recorded on a card at the time of setting out. These included size in its first and second weeks, and when adult; the blooming date, color, size of leaf and of root, and any other facts which seemed likely to be of interest. The plot contained five rows with 100 plants in each row numbered chronologically and recorded on individual cards. These plants were examined once each week for the first three weeks and then as often as the data on the cards required. The soil on which the plants grew was a heavy clay loam with a clay subsoil and had received no treatment except a heavy application of stable manure during the winter.

The leaves were gathered at the usual time—just as the flowers are opening—and enough leaves were allowed to remain to mature the fruit pods. The leaves were then air dried on drying racks in bundles corresponding to the plant from which they were taken, after which they were assayed for alkaloidal content. The error incident to this process was minimized by running the assays in duplicate. Of the 400 samples, 15 were discarded because too small, or because they were spoiled in assaying. The alkaloidal content of the remaining samples, expressed in percentages, was as follows:

Alkaloidal content	*Number of samples*
.0–.09	4
.1–.19	8
.2–.29	26
.3–.39	83
.4–.49	94
.5–.59	65
.6–.69	42
.7–.79	26
.8–.89	25
.9–.99	6
1.0–	6
	385

Mean = .507; σ = .194

The standard of the United States Pharmacopeia is 0.4 atropine in belladona, and the average sample found in the markets varies from this minimum to about 0.6. It is evident, then, that nearly 70% of the plants were above the standard in chemical content, and that six of them yielded 1% or more of atropine—a remarkably high percentage. They were as follows:

1.020
1.000
1.100
1.230
1.030
1.039

Avg. 1.07

Interest naturally centered on these plants, and a study of the records showed that every one of them was small at the time of harvest, while practically all the plants which yielded .01 or less were large and vigorous in growth. Furthermore, the six high plants all had light stems, while the plants yielding .1 or less had dark stems. These characters were the only ones found which seemed to give a clue to

[2] For an outline of some similar work with belladonna and other plants, see "Breeding Medicinal Plants," by F. A. Miller. *American Breeders' Magazine*, IV, pp. 193–201.

ONE OF THE THREE ANNUAL PICKINGS OF BELLADONNA

The belladonna plant, popularly known as the Deadly Nightshade, is closely related to the potato and tomato. The supply of atropine and belladonna used by the medical profession comes from leaves and roots of this plant, but the quality is uncertain. American breeders in recent years have undertaken to produce strains which will have a much higher alkaloidal yield than wild plants; in this way they would not only secure a superior drug, but be able to produce it at a profit, in competition with European growers, who have cheap labor but poor strains of the plant. (Fig. 6.)

the chemical constitution of the plants, but they were marked enough to warrant especial attention during the coming season, when a selected second generation will be grown.

In conclusion, it must be remembered that this work covers only one season and hence must be regarded as merely preliminary. It is highly encouraging to us, however, in indicating the extreme variation of atropine content in the belladonna plant and giving hope that valuable commercial results can be secured by selection.

Deaths Due to Childbirth

In 1913 at least 15,000 women died in the United States from conditions caused by childbirth. This makes a death rate little lower than that due to typhoid; it is a much higher rate than is found in most fore gn countries. The subject is considered in Bulletin No. 19 of the Children's Bureau, by Dr. Grace L. Meigs, who outlines ways in which this mortality can be greatly reduced. A large part of it, she says, is due to superstition and ignorance.

There can be no question of the desirability of reducing the number of deaths from this cause, yet it is worth noting that their eugenic import is not simple. It might be argued that the women who die are on the average mentally, if not physically, inferior to those who survive. If so, this form of death is to some extent selective and eugenic, like infant mortality. The fact that the maternal death rate is twice as high among negroes as whites lends weight to this view.

On the other hand, maternal mortality would be dysgenic, if fear of it prevented superior women from having children, or from having as many children as they would otherwise bear.

But even if this barbarous death rate results in some eugenic gain, that gain can better be secured in other ways, and Dr. Meigs' bulletin, declaring that most maternal deaths are unnecessary, should and doubtless will receive widespread attention.

An Experiment in Long-Continued Inbreeding

More than 25,000 guinea-pigs have been reared by the Bureau of Animal Industry on its experimental farm at Beltsville, Md., to test the effects of inbreeding. Brother and sister have been mated in each generation, and some of the families have now reached the seventeenth generation. While a few strains have run out, others are nearly as vigorous as are the control families. But the important fact is that there is no general deterioriation; the various defects that have appeared are not correlated. One family becomes strong in one respect and weak in another; in a second family conditions are exactly the reverse. Such a state of affairs does not lend any support to the popular idea that inbreeding necessarily produces degeneracy. The various kinds of deterioration are to be accounted for in different ways. In general, the belief of geneticists is apparently confirmed, that even long-continued inbreeding does not necessarily mean deterioration. It tends to make the members of a family more alike, and to perpetuate all variations that occur. If the strain is a good one, inbreeding will improve it; if it is a weak or defective one, inbreeding will bring the defects into prominence and probably lead to the elimination of the strain. When the results of this investigation (which is in charge of Dr. Sewall Wright) are finally published, they should furnish more precise and detailed information about the effects of inbreeding than has heretofore been available.

THE EVOLUTION OF THE HORSE

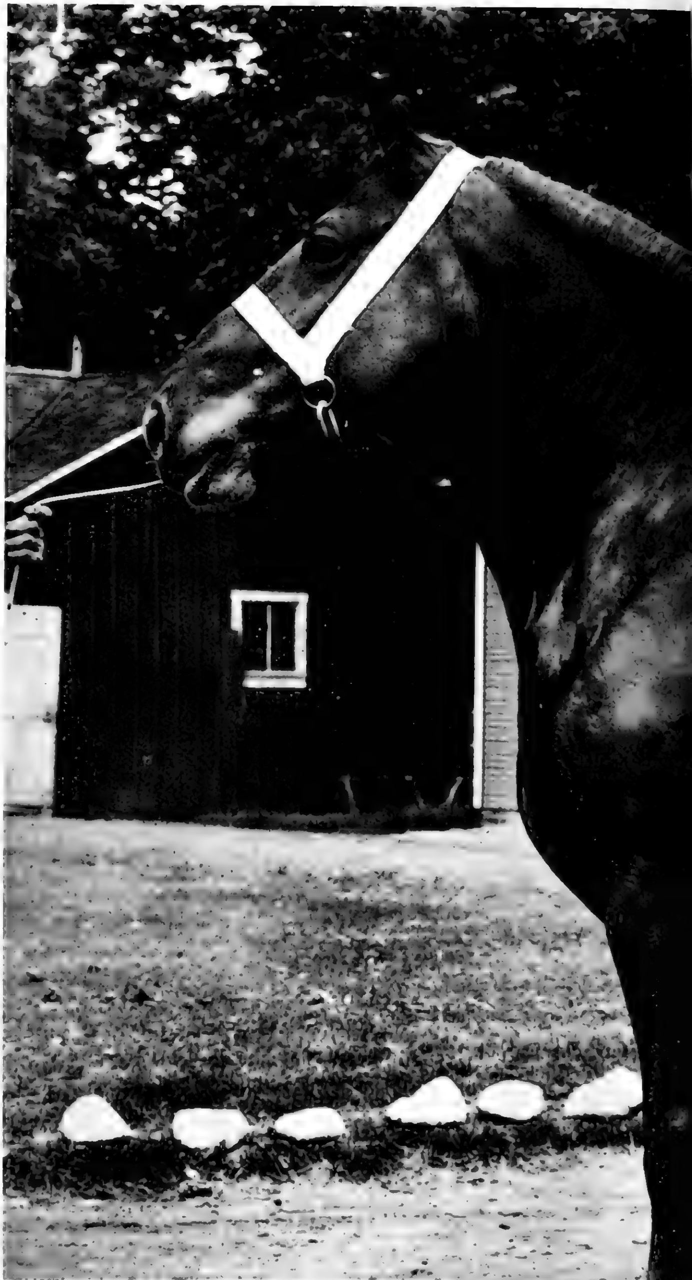
While some animals, as shown in the frontispiece of this issue, have undergone practically no change in a hundred million years or more, other whole groups, such as the mammals, have in only a twentieth or a thirtieth of that time undergone an amount of change that is, by comparison, extermely large. No case of this sort is better known than the horse, who has altered in the last three or four million years in almost every way that a mammal can alter. It further appears that development was not at all uniform during this time; there would be little change for a long period, and then rapid modification would take place.

The only other mammal well enough known to offer a parallel to the horse, in the extent of change that has taken place in a short time, is man himself, whose ancestor in the early Eocene period was probably a little tree-dwelling animal of the tropics which a casual observer might mistake for a squirrel.

The horse of the early Eocene is shown in the small insert below, from fossil remains found in New Mexico, and lately restored by J. W. Gidley, assistant curator of fossil mammals at the U. S. National Museum. This Eohippus was about 14 inches high at the shoulder and had four well-formed toes, with a vestige of a fifth toe. He probably lived around the margins of lakes and pastured on grass.

A Belgian mare, photographed on the same scale, is shown for comparison. The most remarkable change in the course of evolution has been in size, but the loss of all the toes except one is also noteworthy, as well as a great progressive lengthening of the cheek-teeth. It is true, of course, that part of the evolution of the horse has been due, in the last few thousand years, to artificial selection by man. This has brought about much of the increase in size. But the difference between Eohippus and modern wild horses is striking enough.

It is necessary to suppose that the germ-plasm of some species is much more "plastic" and variable than that of others. This is especially true of man and the horse. When man's ancestors came down out of the trees, and when Eohippus emerged from the swamps and began to roam over the prairies, rapid change was possible. (Fig. 7).



STANFORD'S MARRIAGE RATE

Three-fourths of Men Graduates Marry, But Only Half of Women—Possible Reasons for the Difference—Comparison with Other Institutions—Difference May Be Growing Larger

IT IS well known that the marriage rate of men from separate men's colleges is more than a half again as great as that of women graduates from separate women's colleges, but little study has been given to the records of men and women from the same college.

As a contribution to this subject, records of Stanford alumni and alumnae are here given.

Stanford University, near Palo Alto, California, graduated its first class in 1892. Up to and including the class of 1900, it granted 1,095 degrees. The records of these nine classes were studied in the Alumni Directory of 1910, and 95 names were eliminated either because no recent information had been received or because the individual had died. This left an even 1,000 names, 670 men and 330 women.

Of the men, 490 or 73.2% were reported as married, and 180 or 26.8% as unmarried.

Of the women, 160 or 48.5% were reported as married, and 170 or 51.5% as unmarried.

These figures are not absolutely final, since only ten years is allowed the latest class considered, and some of its members who did not marry in that interval would doubtless marry later. It appears probable that this incompleteness is differential, in that it tends to lower the complete marriage rate of the men more than that of the women. After graduation, a man must usually establish himself in business before marriage, whereas a woman is usually ready for matrimony as soon as she has left the university. It seems, then, that women may tend to marry sooner after graduation than do men; it seems very unlikely that the reverse will be the case. If this is true, then any marriages which may have taken place among these Stanford graduates since 1910, or any which may yet take place, will tend proportionately to increase the marriage rate of the alumni more than that of the alumnae.

MEN'S RATE CONSTANT

Although it is not wholly complete, the marriage rate of Stanford men (73.2) is surprisingly close to that of Harvard men (74) and Yale men (78),[1] considering that Stanford is located on the other side of the continent, has an extremely different "atmosphere," and draws from a very different class of students. While the eugenist would like to see as high a marriage rate as possible among such a picked body of men, it is doubtful whether a much higher rate than this can fairly be expected, in view of the fact that many graduates (of Stanford, more than of the eastern universities) enter professions, such as geology and engineering, which are sometimes incompatible with the early establishment of a home.

The women's marriage rate is lower to a surprising degree. Considering that it is probably not complete, it compares favorably with the highest of the separate women's colleges (Wellesley 48, Vassar 49), and is well above the lowest of these colleges (Mount Holyoke 41.9, Bryn Mawr, 43.9).[2] It

[1] Phillips, John C., in Harvard Graduates' Magazine, September, 1916, and Journal of Heredity, vii, pp. 565–569, December, 1916. The Harvard and Yale figures include classes to 1890 only, and are therefore complete.

[2] For these rates see Sprague, Robert J., in Journal of Heredity, vi, pp. 158–162. The rates for women's colleges are compiled in various ways and for various periods, and should not be directly compared with the Stanford rate, unless due allowance has been made for this. They are probably somewhat more complete. For Wellesley, see Johnson, Roswell H., and Stutzmann, Bertha J., in Journal of Heredity, vi, pp. 250–253.

is, however, lower than that of any of the coeducational universities so far studied,[3] viz.:

Stanford, 1892–1900........	48.5
Wisconsin, 1890–1900......	55.1
Oberlin, 1891–1900..........	56.9
Ohio State, 1890–1900......	57.5
Illinois, 1880–1900.........	63.6
Iowa State,[4] 1892–1901....	71.2
Kansas Agr., 1890–1900....	72.5

As far as generalizations may be safely drawn from the few cases available, it appears that the marriage rate of college men is fairly high and constant all over the country; that the marriage rate of college women is on the average considerably lower, but that it shows great variation.

This variation not only reflects differences in the groups from which the students come, but also, it seems certain, differences in the nature of the education. At Kansas State Agricultural College much attention is paid to domestic science, and many girls go there with the deliberate attention of fitting themselves for marriage. In other words, the college (1) selects from the population, to some extent, those girls who are likely to marry and then (2) aids them to marry. At Stanford conditions are quite opposite. Practical domestic science has never been taught, the curriculum is on the whole quite "traditional" in character, and it is particularly in favor with young women who intend to teach. As compared with Kansas, therefore, Stanford tends in some degree (1) to select from the population girls who are less likely to marry, and then (2) to educate them in a way that makes their marriage still less likely.

GIRLS A SELECTED GROUP

To some extent, the Stanford girls of the early classes may have been selected in an unusual way. These early graduating classes are said to have contained some mature women who were already in careers, principally teaching school, and who came to the university to get advanced work. Many of these, at the time they came to Stanford, had passed the age when marriage is likely.

But this statement hardly holds good of the later classes here considered. At that time it appears that there was not any extraordinary selection of the women students of the university; a large proportion of them came because it was fashionable to go to college, and because it was generally reported that girls at Stanford, where men were much in excess, had a better time than at the University of California.

To what extent the alarmingly low marriage rate of Stanford alumnae can be explained by the selective nature of the group of girls admitted, and to what extent it is due to the one-sided education they receive, cannot be decided without intensive study. It is possible here only to analyze the problem in a somewhat speculative way.

INTRA-COLLEGE MATING

Since there were, in the period under discussion, two or more men for every woman in the university, why did not the Stanford women find husbands among their fellow-students? They did to some extent, but apparently not to as great an extent as occurs at many other coeducational institutions. Their failure to do so might be (1) the fault of the men, due to a (*a*) their not being allowed to mingle with the girls in college, or (*b*) their not being "marrying men." But neither of these suppositions has any basis. Social intercourse is not unduly restricted at Stanford, and the figures show that the men do marry in large numbers and fairly early; only, they do not marry Stanford girls.

It might, of course, be alleged that the Stanford men are not good enough for the Stanford women; the ideals of the latter might be supposed to be exceptionally high. The objection cannot be refuted, but is not convincing.

If the failure of the women to marry

[3] Figures extracted from Altman's data (JOURNAL OF HEREDITY, viii, pp. 43–45) for periods which will give a fair comparison with the Stanford figures. The rates are more complete, however, the status being that of about 1915.

[4] J. C. Blumer's data.

is due (2) to some fault of their own, this might be (*a*) a desire not to marry, because of preference for a "career," or the necessity of earning money to support parents; or (*b*) inability to attract men. Both of these reasons are doubtless operative. It is difficult to say which is the more important, since a decision can only be based on personal opinion.

EXTRA-COLLEGE MATING

Though most of the Stanford girls fail to find husbands in college, they yet might do so after graduation. Why do so many of them fail to? Again, it may be (1) that they do not want to marry, or (2) that they want to marry but are not asked to do so. The reasons under (1) would be the same as those considered in the preceding section, namely, preference for a career or necessity of supporting relatives; together with, in some cases, the development of a cynical attitude toward marriage due to faulty education; or more frequently, the demand of a higher standard on the part of suitors than the men of the alumnae's acquaintance can meet.

But it seems likely that the greater part of the women graduates come under (2). They remain unmarried, but not from choice. Their failure to find mates might be because (*a*) they have no opportunity to meet men, due to the nature of the careers which they have chosen, *e. g.*, teaching school; or (*b*) they meet men but fail to attract them, because of physical imperfections, (lack of health or good looks) or educational defects. The latter would include cases of too little emotion, or too much knowledge (a young man is often unwilling to marry a girl who knows more than he does), or lack of the kind of knowledge necessary for home-making, which leads men to discriminate against them and prefer the girl who, it is supposed, will be less extravagant, or who will not need so many servants.

In part explanation of the failure of the Stanford women to marry, it might be urged that the marriage rate of the entire state of California is notably low.[5] But it has been seen that the Stanford men marry in larger numbers; therefore the failure of Stanford women to marry cannot be enentirely credited to external causes. Moreover, Price found[6] the marriage rate of University of California women graduates, 1895–1899, to be 65.7. This would suggest that the low marriage rate of Stanford women may be due in part to their character and raises the question whether this unmarriageable character is inherent and ineradicable, or whether it is mainly due to the faulty education they receive at Stanford or previous to going there.

THE EUGENIC PROBLEM

Eugenically, the problem is clearly defined. A group of young women, which in innate intelligence is probably not surpassed by that of any other American college, has been examined, and it has been found that only half of its members ever marry. This means a racial loss which cannot be viewed with complacency.

It may be granted that many of them, even before coming to Stanford, lean toward celibate careers and away from motherhood. This might be considered to lessen the blame which attaches to the university; or on the other hand, a eugenist might argue that, when confronted with a group of girls selected in that way, the university ought to make all the more effort to change their ideals.

This point does not mitigate the eugenic gravity of the problem itself. It could be mitigated only by showing that these girls are germinally deficient

[5] California's yearly record of 228 marriages per 10,000 unmarried adults is the lowest of any State in the Union (see Bureau of the Census, Bulletin 96, p. 14, 1914). But this does not tell the whole story, for census figures (13th Rep., Vol. i, p. 528) also show that the percentage of adult females in California who are unmarried is smaller than that in three-quarters of the other states.

[6] See *San Francisco Examiner*, October 1, 1916, or JOURNAL OF HEREDITY, January, 1917, p. 43.

in emotional equipment or in some other way which makes it advantageous to the race that they be thus sterilized.

Such a contention will hardly be given more than a very limited application. It can hardly be doubted that most of the Stanford women are of precisely the type whose eugenic contribution the race most needs.

If this is admitted, then the conclusion can hardly be avoided that a change is required in their education, which, instead of fitting them only to be celibate school teachers, will give them, as well, the intellectual and emotional training needed for marriage and motherhood. This would not make all the graduates want to marry, nor would it enable all those to marry who want to, but it would at least raise the marriage rate.

PRESENT CONDITIONS

Of course, it might be supposed that the marriage rate of Stanford women at present is higher than it was fifteen or twenty years ago. But it is probably lower rather than higher, because of an unusual sort of selection to which the girls are now submitted.

A provision was inserted in the university's charter that the number of women students should at no time exceed 500. The number of men students is not limited by charter. For some years past, hundreds of girls who have desired to enter the university have been unable to do so, because the charter limit had been reached. In order to meet this problem, the university has tended more or less consciously to raise the standards required of young women for entrance, so that those who are admitted become each year a more picked lot, as measured by their scholarship. They are, on the average, noticeably superior to the Stanford men in this respect. This selection tends to bring to Stanford, more and more, only girls who are seriously preparing for a pedagogical career, or who are of studious tastes; it tends to eliminate those who come to college mainly from social reasons. The marriage rate of this more studious type of girl is probably lower under any conditions.

Such being the case, she admittedly offers a difficult problem. Several possible ways of mitigating the untoward result, however, suggest themselves:

1. To remove the limitation of women students to 500 and to lower the standards for women would not impair the quality of the superior students who now come, but it would dilute their number with girls who are more socially-minded, and who would exert a eugenic influence on them.

2. Considering the type of girl with whom they have to deal, the university authorities could make a particular effort to encourage social life.

3. The curriculum could be broadened so that it would fit graduates for a wider group of activities, especially those which center in the home.

Of course, if Stanford believes it is fulfilling its duty to the nation more effectively by producing school teachers for the present generation than by producing mothers of a nobler race to come, these suggestions are quite unnecessary.

The Standards of Sexual Selection

Students (41 women and 27 men) of Prof. L. L. Bernard, department of sociology, University of Missouri, were asked for anonymous statements as to the requirements of persons they would marry. Most of the women placed moral character first in a husband, congeniality and good disposition coming next. Income and social standing were given considerable weight, while age seemed to have minor importance. The men made beauty their chief requirement, character, youth, and training in domestic science also being considered important. It is interesting to note that the men tended to attach some weight to heredity, while the women did not.

ORTHODACTYLY

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IN 1901 G. Walker described a family marked by inherited stiffness of finger joints, and in 1915 Harvey Cushing compiled the genealogy, through seven generations, of another such family comprising 452 individuals.[1] These were all descendants of one William B., who had come to Virginia from Scotland about 1700.

I have recently found a family which shows the same peculiarity. It is not included in Cushing's chart, but probably derives the trait from the same source, since family tradition traces it to ancestors in Scotland.

It is not the purpose of this paper to give the anatomy of the stiff joints, but only to point out their inheritance. The joints affected are the second ones of the fingers and frequently the corresponding ones of the toes. The joints are absolutely rigid. That the bones are not always fused is evidenced by the fact that one case is known where the joint was accidentally disjointed. The abnormality may occur in two, three or four of the fingers.

This trait behaves as a Mendelian dominant. Whenever the trait does not occur in an individual that person is unable to transmit it, that is, the normal hand is recessive to this trait and cannot transmit it.

Inspection of the chart shows the following facts. If we discard the D generation where the size of the family is small and consider only the B and C generations, we find that the number of affected individuals is eleven and the number of normal is four.

As only part of generation B shows the trait, it evidently was not homozygous in generation A. Further, as it appears to be a dominant trait, it could not have been carried by the mother in generation A, since she would have shown it if she had it. This leaves only one possible type of mating to fit the fact—a mating of heterozygous dominant with homozygous recessive. From such a mating it would be expected that affected and normal offspring would be produced in equal numbers, or 7.5 : 7.5, whereas the figures actually found are 11 : 4. This is very poor agreement, although not impossible when the numbers involved are so small.

Cushing charts 150 children from such matings, of whom 78, or 52%, were affected. This is so near the expected 50% as to make it practically certain that the abnormality is due to a single Mendelian factor.

Recent work of Cushing, Marie and others makes it seem probable that the trait here studied is related to some prenatal interference with the normal function of the pituitary body. Its apparent relation with brachydactyly, a well-established Mendelian character, is evident.

Cushing has called this trait symphalangism, a good descriptive term. Before I knew of his work I called the trait orthodactyly, or straight finger. As this trait is so similar in character and inheritance to other digital abnormalities it seems that it would be better to give it a similar name; however, the name is of little consequence.

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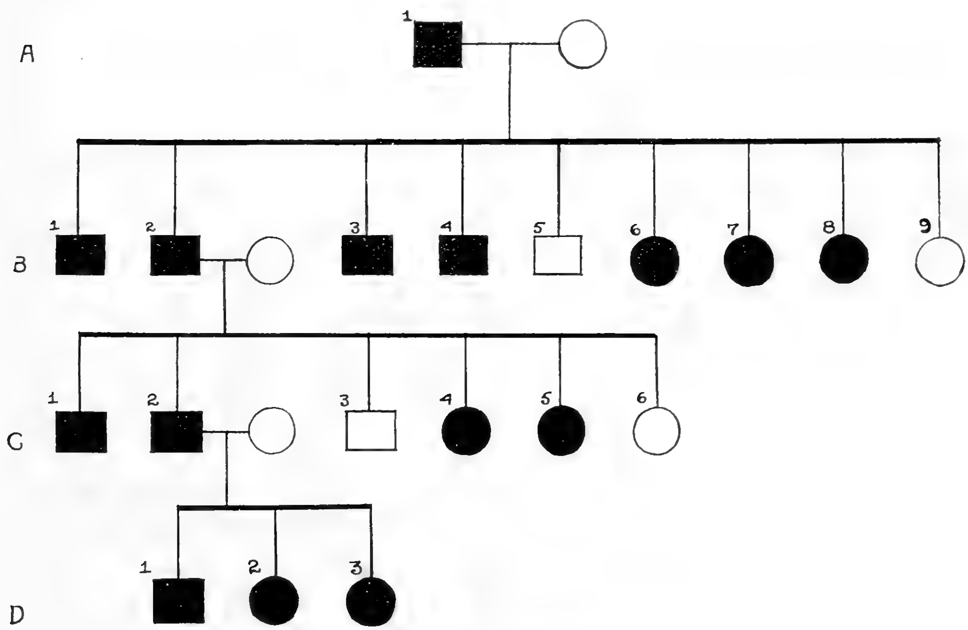
[1] Cushing, Harvey. Heredity anchylosis of the proximal phalangeal joints (symphalangism). Genetics, i, pp. 90–106, January, 1916.

THE EFFECT OF ORTHODACTYLY

At the left is a hand with the third, fourth and fifth fingers affected. The middle joints of these fingers are stiff and cannot be bent. At the right the same hand is shown, closed. A normal hand in the middle serves to illustrate by contrast the nature of the abnormality, which appears in every generation of the family. (Fig. 8.)



A FAMILY WITH ORTHODACTYLY

Squares denote males, circles females. Black squares or circles denote affected individuals. A1 had all fingers affected; B2 had all but one finger affected; C2 had all but one finger affected; D2 had all fingers affected; D3 has all but forefingers affected. (Fig. 9.)

AN ORANGE BUD VARIATION

THE accompanying photograph shows several variegated branches borne by a normal Valencia orange limb and tree in California. Propagations of similar variations of citrus trees have been made successfully by the writer. The fruits borne by the variegated citrus propagations have usually been found to be somewhat ridged, and variegated in color like the variegated leaves and branches. Such fruits are usually of

BUD VARIATION OF ORANGE. (Fig. 10.)

inferior commercial value but intensely interesting from the standpoint of showing the occurrence of striking variations in citrus varieties and the possibility of isolating and propagating them through bud selection.

Some authors (see discussion of bud variation in Darwin's "Variation of Animals and Plants under Domestication") believe that variegations of foliage, such as that shown in the photograph, are the result of disease. They also seem to believe that when a variegated bud is inserted in a normal stock it will inoculate the stock with the disease, which they claim causes the variegation, so that branches of the stock other than those grown from the variegated buds will show variegation.

I am very sure that such is not the case in the citrus fruits; for instance, in 1912 I rebudded a healthy and normal Eureka lemon tree in one of our performance record blocks. On one half of this tree I used buds cut from a variegated branch sport of a neighboring Eureka lemon tree. On the other half of the rebudded tree I used buds from the healthy branches of the tree bearing the variegated limb sport. The branches, leaves, and fruits grown from the variegated buds have all shown the characteristic variegated condition of the branches, foliage, and fruits of the variegated limb sport. On the other half, the branches, leaves, and foliage grown from the normal buds are all normal in every respect and have continued to be so from the beginning of this experiment. In other words, the variegated branches on the rebudded tree have not influenced, so far as variegation goes at least, the branches grown from the normal buds on the other half of this tree. I have had several similar experiences with both lemons and oranges, which have led me to the conclusion that the use of variegated citrus buds does not influence in this respect any other branches grown from a stock than those developed from the variegated buds.

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Tuberculosis among Natives of Alaska

One of the greatest problems in Alaska is how to stop the advance of tuberculosis among the natives, according to the annual report of the Bureau of Education. At the Nome Hospital, for instance, practically all the deaths which occurred were due to this disease. It is not generally recognized that this represents evolution through natural selection. The white races have become relatively resistant to phthisis, due to the death of the least resistant stocks, generation after generation, for thousands of years. But the disease was not known in America until after the time of Columbus, and all the American natives are therefore unselected against it. When whites and natives live side by side, and similarly when whites and negroes live side by side, the white man's disease, tuberculosis, finds most of its victims among darker race.

Ossification of the Bones of the Hand

The bones of the hand are first laid down in elastic cartilage, but before the birth of a child lime has been dedeposited in them and they have been ossified enough to be relatively hard. Prof. J. W. Pryor, of Kentucky University, has been studying this process, and among the conclusions which he reported at the last annual meeting of the American Association of Anatomists are several of general interest. He finds that the bones of the female ossify in advance of those of the male, and that the bones of the first child ossify, as a rule, sooner than do those of subsequent children. This corresponds to many observations on different features, which show that the order of birth has a real influence on a child's character. Variation in the ossification of bones, Professor Pryor concludes, is a heritable trait.

THE INCREASE OF IGNORANCE

Wards of Pittsburgh with Most Illiterates and Most Foreign-Born Have High Birth-Rate and Also Show Lower Infant Mortality than Some of the Best Educated and Prosperous Wards

THE EDITOR

IT is the function of Art to isolate different aspects of life and hold them up for observation. The onlooker must not "go behind the returns." If you are looking at the Venus de Milo in an esthetic frame of mind, you must see nothing but a statue and an idea in it. If you begin to wonder about her pedigree or whether the Greeks really had such straight noses as she has, you are no longer studying art, but science. For science deals not with things as they are, but with things in relation to each other.

One of the most ingenious and satisfactory ways of showing the relations of things to each other is by applying the calculus of correlation, a branch of higher mathematics which has been extensively developed during the last generation. Isolated statistical facts which seem to have little or no meaning can be treated with it and at once take on life—at once allow the student to project the picture forward, so that he sees not only what is now happening but what will happen in the future, under certain conditions. The accuracy of the picture is limited only by the exactness of the original facts. The present paper undertakes to give a rough illustration of how the calculus of correlation may be applied to the vital statistics of a city to bring out their significance. The city chosen is Pittsburgh, from which Prof. Roswell Hill Johnson has turned over to me some data which Miss Sadie Scorer, one of his students, compiled a few years ago, but did not use. They show the birth-rate, infant mortality, number of illiterates, proportion of native whites of native parentage, and various other facts about each of the twenty-seven wards into which Greater Pittsburgh is divided.

I have never been in Pittsburgh, but as a newspaper reader I picture it as a huge, smoky, industrial center with something like three-quarters of a million inhabitants, and containing great extremes of wealth and poverty, innumerable millionaires on their magnificent estates, and vast, overcrowded quarters where tall chimneys of factories jostle each other, and where a population of laboring people, largely foreign-born and ignorant, lives on the edge of the financial dead-line.

An inspection of Miss Scorer's figures as they stand is sufficient to give me some idea of the make-up of the metropolis. But I want to watch its vital processes; to see the changes taking place year by year and thereby get an idea of what it will be in the future; just as the surgeon studies the case history of his patient and arrives at a prognosis. For this purpose nothing is more convenient than the calculus of correlation.

CORRELATION

It is a matter of common observation that there are all sort of correlations in daily life; that certain things go together, and that an increase in one factor will necessarily cause an increase in some other. For example, if the population of a city increases, the amount of food consumed in the city will also increase; the two facts are closely correlated. And one might also guess that as the number of births increases, the number of deaths will also increase; there are more people to die, and die they must, soon or late.

Now the exact amount of association between two things is nicely measured by the calculus of correlation, and expressed in a coefficient which is a decimal fraction somewhere between 0 and +1 or −1. If the correlation is

0, we know that there is no constant relation, no resemblance, between the things we are correlating. If it is unity, we know the correlation is absolute; that if one factor changes ever so little, the other must change in a corresponding amount. Generally, a correlation above .5 is considered distinctly high.

It must be said that the picture which we will get of Pittsburgh is only an impressionistic one. The data available are coarse, and as we cannot treat a smaller unit than a whole ward, we cannot use any great refinement of method. It will be all the easier, however, to see the general outlines of the picture, and I think that they will be accurate.

With this preliminary warning we examine the connection between birth-rate and infant mortality, our measure of the latter being made by dividing the number of deaths under one year in a ward by the number of births in the same ward for the same year (1912), while the birth-rate in the various wards was computed by dividing the total number of births per ward in 1912 by the total number of females in that ward in the same year. This is not an accurate measure, because the proportion of unmarried women may be larger in some wards than in others, but it is the best available. Arranging the twenty-seven wards in the order of their birth-rate, from the highest to the lowest, and then ranking them for infant mortality (1912) in the same way, we find the correlation between the ranks[1] in respect of these two facts is only .307. This is much lower than one would have anticipated, and in comparison with its probable error[2] is of little significance. We must conclude that in 1912 there was little or no connection between birth-rate and infant mortality in Pittsburgh, contrary to what one would expect who has heard the birth control propagandists insisting that a high birth-rate means a high rate of infant mortality. Here we find that we cannot judge, by knowing how a ward stands in respect to birth-rate, whether or not it will have higher, or lower, rank in respect to infant mortality. The two facts have little connection—it is evident that each is influenced by many causes, which may be stronger in one case than in the other.

INCREASE OF POPULATION

As the first year of life is by far the most fatal one, we can reach a measure, rough but sufficient for our purpose, of the rate of first-year increase of various parts of the population, by deducting the number of deaths (1912) under one year of age from the number of births in the same year. We will make this comparable by dividing the figure so obtained by the population of the ward, and for convenience we will call the resulting rate the net increase, although it is in fact a percentage.

The net increase, we find, depends almost absolutely on the birth-rate, the coefficient being .978; but it has little relation to the infant mortality, with which it is correlated to the extent of only .245 with a large probable error. That is, the birth-rate largely determines which ward shall show the greatest increase of population, the infant mortality exercising little effect in this case. The point is important, because we are sometimes told that even though the superior classes of a community have a low birth-rate, yet the infant mortality among them is so much lower than that of the slums, that in the end they manage to hold their own. We shall see still more striking evidence, a little later, that this was

[1] The correlation coefficient was corrected by means of Pearson's table (Draper's Company Research Memoirs, Biometric Series IV, 1907, p. 18). As indicated above, I am under no illusions about the exactness of the method of ranks, but it is the only one applicable to Miss Scorer's data. The probable error is relatively large because of the small number of cases (twenty-seven). I must add that I am not responsible for the accuracy of the original data, but only for the correlations. I believe the data to be accurate for the present purpose, but I have not placed much weight on the absolute values reached. The relative values are the important ones from a eugenic standpoint and as far as I can see they are accurate enough at least to show the general trend. I am indebted to Dr. Sewall Wright for counsel and criticism in this study.

[2] See complete table of coefficients and probable errors at the end of this paper.

not the case in Pittsburgh in 1912.[3] A moment's consideration will show that the result we obtained was to be expected; for the infant deaths in a year are only about 10% of the births in a year, and therefore any variation in the rate of infant mortality would be insignificant in causing a variation in the rate of first-year increase. If all the deaths up to maturity could be counted, we might conceivably find that the mortality in the worst wards was great enough to leave the best wards in the lead. It is, however, highly improbable that this is the case: the data available do not offer any information on the point.

EFFECT OF ILLITERACY

We know in a general way that the ignorant and less prosperous part of the community produces the most children, but we rarely get figures to show just how close the association of these two facts is. In the Pittsburgh statistics, however, we find the number of illiterates in each ward stated. Now if many of the residents of a district can neither read nor write, it is probably safe to assume that that population is below the average in intelligence. Grading the various wards in this way, and correlating with the net increase, we get a coefficient of .731. Here is a very high degree of association, which proves that the performance is regular—the more ignorance, the more babies. Advocates of birth control will perhaps read a meaning into this. They would doubtless expect likewise to find infant mortality highly correlated with illiteracy, but here there is another surprise. The coefficient is $.254 \pm .129$—that is, not significant. The infant mortality is higher in some of the well-to-do and supposedly intelligent wards than it is in some of the illiterate factory and slum districts.

This seems to me to be the most important fact which Miss Scorer's data reveal. It is desirable to see the exact figures in this case, and I give them in tabular form below. The rate for infant mortality is, as stated above, got by dividing the number of deaths under one year in a ward by the number of births in the same ward, both figures being for the year 1912. The rate of illiteracy is got by dividing the total number of illiterates by the total number of people 10 years of age or over in the ward, both figures again being for 1912. It is not clear how the census defined an illiterate person—presumably children were excluded, at least. Whatever the standard may have been, it was the same for all the wards, so that the comparison of wards is fair even if the standard leaves something to be desired. The figures follow:

Ward	*Illit. rate*	*Rank*	*Inf. Mort. rate*	*Rank*
1	5.98	10	.098	14
2	17.2	2	.040	25
3	8.77	6	.092	18
4	8.26	7	.104	12
5	4.12	16	.037	26
6	24.4	1	.138	3
7	0.74	27	.085	20
8	4.33	13	.098	15
9	5.05	12	.114	9
10	4.07	17	.119	8
11	2.42	21	.061	23
12	6.90	8	.041	24
13	2.79	20	.079	21
14	1.96	22	.078	22
15	6.08	9	.095	16
16	9.39	4	.122	7
17	11.1	3	.132	5
18	3.53	19	.032	27
19	3.57	18	.093	17
20	4.24	14	.105	11
21	5.25	11	.138	4
22	1.73	23	.232	1
23	4.14	15	.166	2
24	1.52	24	.099	13
25	1.35	25	.086	19
26	0.81	26	.113	10
27	9.11	5	.125	6

It seemed very desirable to know whether this state of affairs existed only in 1912, or was permanent, so the infant mortality rates of the various wards in 1913, 1914, and 1915 were secured from the Board of Health, and correlated with the illiteracy of the wards for 1912. In 1913 the correlation was $.558 \pm .042$, a much better showing for the more

[3] In only one case was I able to determine whether or not 1912 was an exceptional year for Pittsburgh's vital statistics. The infant mortality for both 1912 and 1911 was given; correlating the ranks of the wards for this I found an association of .94, which shows that there was little change in the position of the various wards between those two years.

intelligent wards. In 1914, when the infant mortality all over the city was low, the correlation with illiteracy was .062, sensibly zero. In 1915 it was .654.±058.

It appears, then, that in two of the four years the most intelligent wards had the lowest rates of infant mortality, but in the other two years there was no constant association between intelligence and a low rate of infant deaths.

The case is not without a parallel. Dr. Devine mentions[4] that in Manhattan Island (New York City) the death-rate for children under 5 is lower below Fourteenth Street than above Fourteenth Street, and in this lower section, the death-rate is less on the East Side than the West Side. "The wards making up the notoriously congested parts of the city, which are predominantly Jewish, the seventh, tenth, eleventh and thirteenth, have relatively a low rate of child mortality, while the wards with the highest rates, the fourth, sixth, eighth and fourteenth—the first has so small a population that the figures mean very little—are predominantly Italian and Irish-American, with the Chinese quarter also in the sixth." Dr. Devine's conclusion is that the difference is racial, the Jews showing a low death-rate regardless of crowding; but in Boston the Jews were found to have a very high death-rate.[5] The explanation of the low death rate of children in the congested parts of New York city seems, then, to be obscure; and it is equally so in Pittsburgh. Perhaps more breast-feeding accounts for some of the lower infant mortality in the poorer districts; and perhaps the infant mortality campaign there is entitled to some credit.[6] In a modern city nowadays the children of the poor, aided by many charities and philanthropies, sometimes get more intelligent care than do the children of the rich, who are turned over to ignorant maids. These various causes are probably all at work to lower the correlation between illiteracy and infant mortality; and there must be other and perhaps more important causes which could only be learned by a careful study of conditions at close range. Whatever the causes, the result is certainly not creditable to the wards of Pittsburgh which are supposed to be the more intelligent and progressive.

RACIAL DIFFERENCES

It might have been supposed that racial differences would be important here, but they are not shown to be so by our figures. As there is a high negative correlation (−.697) between the proportion of native whites of native-born parents in a ward and the number of illiterates in that ward, we do not expect to find that the proportion of native-born residents in a ward determines the infant mortality to a large extent. In fact, it appears to determine it not at all, for the correlation between infant mortality and the percentage of native whites of native parents in a ward is −.139±.133 or sensibly zero. The old American families of Pittsburgh doubtless consider themselves superior in every way to the illiterate immigrants of the slums, but the rate of infant mortality among them may well make them blush.

All these interacting causes, and many others which our study does not show, contribute to the great outstanding fact of eugenic importance—namely, that the illiterate foreigners are swamping the older and better educated, native American part of the population, not only by a higher birth-rate, but in many cases by a lower rate of infant mortality. The net increase of population (in the meaning we have given this term) is greatest, where the foreigners are most numerous. The correlation between the percentage of native whites of native parentage, and the net increase of a ward is negative, −.673. Not only are relatively few children born in the

[4] Devine, Edward T. Prevention of Infant Mortality. American Academy of Medicine Conference, New Haven, 1909, pp. 100–102.

[5] Cabot, Richard C. and Richie, Edith K. *Ibid.*, pp. 113–125.

[6] The number of deaths under 1 year of age, per 1,000 births, in Pittsburgh is as follows: 1911, 122.6; 1912, 126.7; 1913, 127.1; 1914, 114.7; 1915, 107.7.

prosperous, old American families, but relatively many of these few die in infancy.

The net increase of Pittsburgh's population, therefore, is greatest where the percentage of foreign-born population is greatest and where the percentage of illiteracy is greatest.

The nature of Miss Scorer's data makes it impossible to compare the situation in Pittsburgh directly with that existing elsewhere; but knowing the relations between the various wards in respect to birth-rate, infant mortality, illiteracy and racial make-up, we are justified in finding how far these factors are associated in other parts of the United States. The Children's Bureau has made some studies of this sort,[7] and Miss Ethel M. Elderton of the University of London has fortunately worked out coefficients of correlation from them.[8]

A STUDY IN MASSACHUSETTS

Taking thirty-two Massachusetts cities, it was found that infantile mortality and illiteracy were associated to the extent of .70 while infantile mortality and the percentage of foreign-born population were associated to the extent of .74. The percentage of women employed was also known, and this was found to be associated (.68) with a high infant mortality. It would of course be an error to assume that this latter correlation proves that employment of women *causes* all the infant mortality; for it is associated with illiteracy and foreign race, both of them known to be important factors in infant mortality; and with many similar factors which were not measured—for instance, much employment of women means industrial conditions in a town and therefore very likely crowded dwellings and a general bad environment with poverty and drunkenness. Miss Elderton showed, from the figures of the Children's Bureau, that illiteracy itself had little influence on the rate of infantile mortality, the presence of foreign-born in a city being much more important. When the correlation (.68) between infant mortality and employment of women was reduced by eliminating the factors of illiteracy, foreign-born population, and bad industrial conditions, 60% of it turned out to have been due to these three factors. In other words, employment of women is important more as an index of other bad conditions, than of itself, in affecting infant mortality.

This digression to the industrial towns of Massachusetts is sufficient to show that Pittsburgh is not alone in having illiteracy and a foreign-born population associated with a high birth-rate, but that its infant mortality figures are unusual. Let us now go a little deeper in our study of the condition of Pittsburgh in 1912.

Ward seven particularly struck me, as I went over the figures, because it stood so high in nearly everything. Of its 5,622 males of voting age, only twenty-four were returned as illiterate. It has the lowest death-rate of any ward in the city, and the lowest number of cases of tuberculosis reported from month to month. It was the only ward in the city where more than half the inhabitants (56.4% in this case) were native-born of native parents. It is in the "East End" of the city, bounded by Neville, Fifth, Penn and Center Avenues, remote from the factory district, and has many schools and churches. Except in a few streets, Prof. Johnson tells me, its houses are of fair or large size. It contains many of the large and more expensive apartment houses. It is evidently the residence of many of "our best people."

In most respects, it may well be a source of pride to Pittsburgh, but eugenically it must be a source of alarm:

It has the lowest birth-rate and the lowest rate of net increase (as defined in this paper) of all the twenty-seven wards of the city.

The sixth ward, on the other hand, runs along the south bank of the Alle-

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[7] Report on Condition of Women and Child Wage-Earners in the United States, Vol. xiii. Infant Mortality and Its Relation to the Employment of Mothers. Department of Labor, Washington, D. C., 1914.

[8] *Biometrika*, Vol. x, pp. 193–196, London, 1914.

ghany River whence it is popularly called "The Strip;" it is one of the great factory districts of the city but also contains a large number of working-men's homes. Nearly 3,000 out of a total of 14,817 males of voting age are illiterate. Its death-rate is the highest in the city. Almost nine-tenths of its residents are either foreigners or the children of foreigners. Its record is black in most ways.

And its birth-rate is three times that of the prosperous, educated, intelligent, superior, seventh ward.

It is true that a larger proportion of the children in these factory homes die, but the infant mortality is not enough greater to reduce their gain very much. When the net increase is computed, the ignorant sixth ward is found third from the top, while the intelligent seventh stands eighth from the bottom.

BREEDING FROM THE BOTTOM

The significance of such figures, for the future of the city, must be perfectly evident. Pittsburgh (like probably all other large cities) breeds from the bottom.

The lower a population is in the scale of intelligence, the greater is its reproductive contribution. When we recall that intelligence is inherited, that like begets like in this respect, we can hardly feel encouraged over the population of Pittsburgh, a couple of generations hence.

Of course, these foreign laborers, from a eugenic point of view, are not wholly bad. I do not wish to paint the picture any blacker than the object. Many of these illiterate stocks, in another generation and with decent surroundings, would furnish excellent citizens.

But taken as a whole, the fecund stocks of Pittsburgh, with their illiteracy, squalor and tuberculosis, their many saloons, their economic straits, can hardly be considered as eugenic material as the families that are dying out in the fashionable residence section which their fathers created in the eastern part of the city. If they were, they would not be where they are.

And it can hardly be supposed that the city, and the nation, of the future would not benefit by a change in the distribution of births, whereby more would come from the seventh ward and its like, and fewer from the sixth and its like.

If the more ignorant stocks of the city are reproducing three times as rapidly as the more intelligent, the proportion of inefficient people in the city is going steadily to increase. And it is now increasing—not only in Pittsburgh but, to a much less degree no doubt, in the whole nation.

The problem of eugenics is to alter this trend.

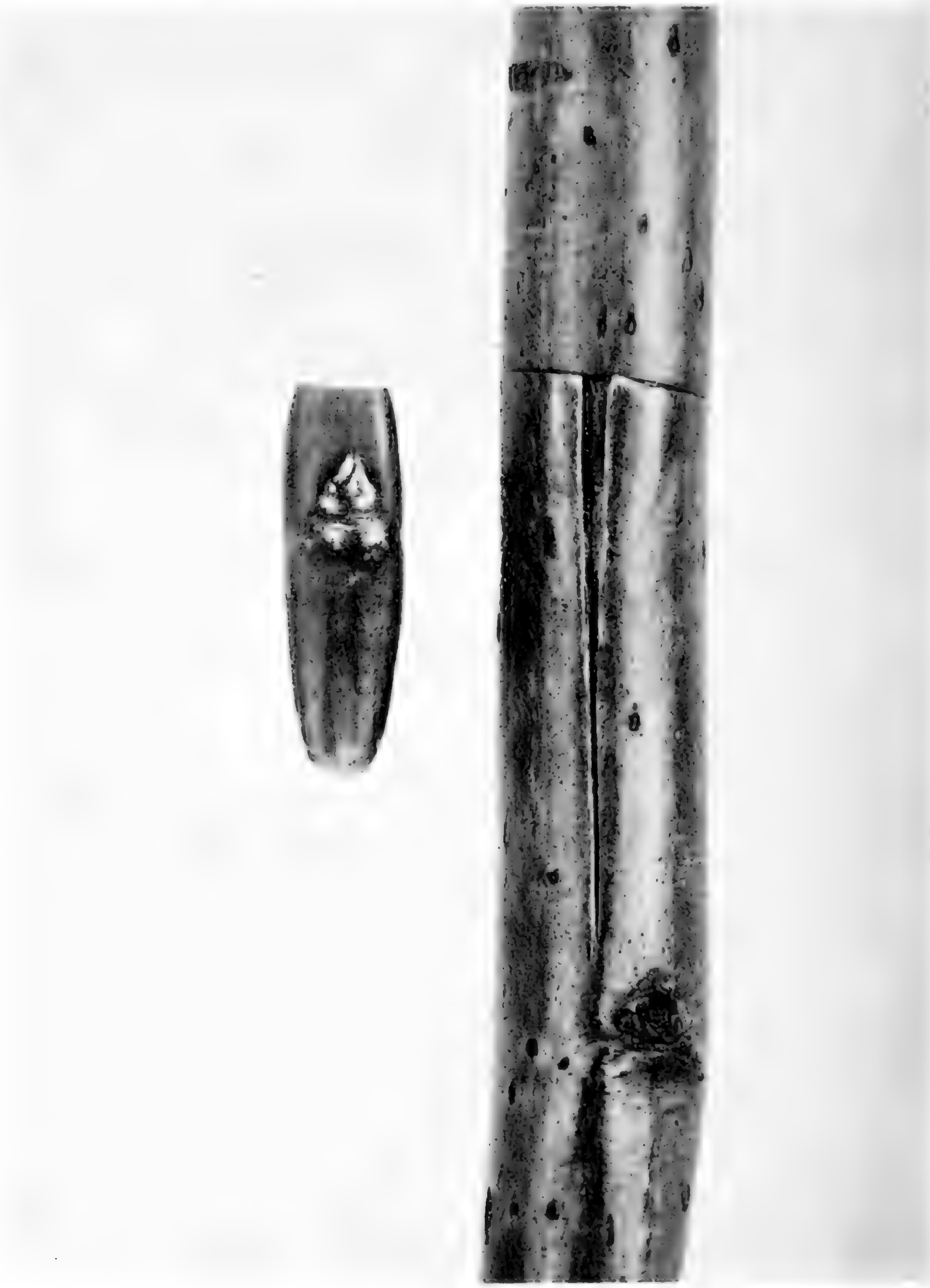
PITTSBURGH WARDS, 1912

Illiteracy and net increase		$.731 \pm .063$
	Per cent native born	$-.697 \pm .07$
	Infant mortality	$.254 \pm .129$
	Birth rate	$.753 \pm .059$
Birth rate and illiteracy		$.753 \pm .059$
	Infant mortality	$.307 \pm .136$
	Net increase	$.978 \pm .128$
	Per cent native born	$-.755 \pm .058$
Net increase and per cent native born		$-.673 \pm .074$
	Birth rate	$.978 \pm .128$
	Illiteracy	$.731 \pm .063$
	Infant mortality	$.245 \pm .128$
Per cent native born and infant mortality		$-.139 \pm .133$
	Illiteracy	$-.697 \pm .07$
	Birth rate	$-.755 \pm .058$
	Net increase	$-.673 \pm .074$
Infant mortality and per cent native born		$-.139 \pm .133$
	Illiteracy	$.254 \pm .129$
	Birth rate	$.307 \pm .136$
	Net increase	$.245 \pm .128$

Experiments with Potato-Beetles

The plant used by W. L. Tower at Tucson, Ariz., in his studies on potato beetles is being entirely rebuilt, according to the annual report of the Carnegie Institution. Dr. Tower's breeding experiments have now gone as far as the eighteenth generation, in some cases. He states that his stocks are producing mutations and that he is securing valuable new evidence on adaptations to climatic conditions. At least one progressive mutation is reported.

THE OPERATION OF BUDDING



Choice fruit and other trees usually do not come true to seed; if their quality is to be perpetuated, they must be propagated asexually, and budding is one of the best methods. It is a simple operation which deserves to be better known and more used by amateurs. It may be performed whenever bark will peel, and whenever mature buds can be secured; this means in early spring and again in late summer and early autumn. A tree of one species in most cases must be budded on another of the same or a closely related species, the bud being taken from a choice variety and inserted either on a rapidly growing shoot of a large tree or on a young seedling. The bud must be taken from a twig about the size of the one on which it is proposed to place it; usually one of the diameter of a lead pencil, or of the little finger, is used. The above photograph, by John Howard Paine, is enlarged. (Fig. 11.)

BUD INSERTED ON THE BUDSTOCK

As shown in this and the preceding illustration, a T-shaped incision is made in the stock, and the edges of the bark lifted up. A bud is then sliced off with about an inch and a half of bark, care being taken to bring with it the soft inner bark (cambium layer) and a thin slice of the hard wood. If the bud is in the axil of a leaf (as above) the leaf is cut off The bud is very carefully slipped in as shown under the bark, using the stub of the loaf as a handle. Photograph, much enlarged, by David Fairchild. (Fig. 12.)

WRAPPING OR TYING THE BUD

The soft inner bark or cambium layer of the edges of the cut bud being closely in contact with the cambium layer of the shoot or so-called stock, the bud is then wrapped rather tightly. Yarn was formerly used for this purpose but now everyone uses moist raffia, the stripping of an oriental palm which is much used in basketry and which can be secured from most seedsmen and florists. Photograph, much enlarged, by David Fairchild. (Fig. 13.)

THE STOCK CONTINUES TO GROW

Its expansion is beginning to burst the raffia wrapping. After two or three weeks, when the bud has "taken," the wrapping must be removed; if the stock is growing rapidly, it may have to be removed, or at least loosened, after ten days. In the case photographed, the raffia should have been removed earlier; although some disfigurement is inevitable when raffia is used. Photograph, much enlarged, by David Fairchild. (Fig. 14.)

WHEN THE BUD IS UNWRAPPED

In a couple of weeks or so, depending on the species, the bud has united firmly with the stock, and the wrapping is removed. The shoot has been badly cramped, but will not suffer permanently. In this case the bud has been somewhat disfigured, but not injured, by the exudation of cherry gum. Photograph, much enlarged, by David Fairchild. (Fig. 15.)

THE NEW BUD BEGINS TO GROW

The bud soon puts forth leaves, and may make a growth of several feet in the first year, if it was budded in early spring. If the operation was performed late in the summer or fall, the bud ordinarily lies dormant until the next spring, when it begins to grow rapidly. Photograph much enlarged, by David Fairchild. (Fig. 16.)

AN OLD BUD UNION

After the bud has made a few feet of growth, the stock is cut off just above it, so the bud takes the place of the former branch. In case the bud was put on a seedling, this means that practically all of the tree above ground is due to the bud, the underground part being furnished by the stock. Quick growth is usually made by such a tree, because of its strong root system. A peach tree budded in the fall on a vigorous seedling will sometimes attain a height of 6 feet the next year, and be ready to sell or plant, a year from the time it was budded. The tree above is a budded orange growing in a pot, photographed by G. W. Oliver. (Fig. 17.)

CUT OUT THIS PAGE

and hand it to some friend who is interested in plant-breeding, animal-breeding, or eugenics.

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The

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Date of issue of this number, APRIL 25, 1917.

A BIRD WITHOUT WINGS

There are many birds which cannot fly, and some which have not even wings. One of these (shown above) is the Apteryx of New Zealand, called by the natives kiwi-kiwi. The most superficial observer would at once remark that this bird lacks something, since it reminds one of a man without arms; for the wings are totally absent, and the place where they should be is covered with a close smooth growth of hair-like feathers. It is known that the ancestors of the kiwi had wings, and the problem for evolutionists is how it came to lose them. August Weismann pointed out that the wings were of no use to the bird, since it lives on the ground and hunts worms by night. It has no need of wings to obtain its food; nor to escape from enemies on the ground, since there are no native mammals except bats in New Zealand. In fact, wings might be rather a hindrance than otherwise to the kiwi in moving quickly through thickets and underbrush. Birds which were born with defective wings, therefore, were not penalized by natural selection; and as variations which would spoil a complicated structure like a wing are much more frequent than those which would make it more perfect, the wings gradually degenerated until they became mere rudiments which are externally altogether invisible. Evolution works both ways, and causes improvement or degeneration, according to external circumstances. Photograph by E. R. Sanborn, New York Zoölogical Society. (Frontispiece.)

THE UTILITY OF DEATH

Evolution Could Not Take Place without It, Because the Higher Forms of Life Are so Specialized that They Cannot Change Much in a Single Lifetime—Death Therefore an Adaptation for the Benefit of the Species—the Trend of Evolution[1]

F. H. Pike

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THE question why living organisms should die is a biological question just as truly as is the question why or how they live, and it should be possible therefore to formulate in terms of the great biological processes and of the properties of living matter some general considerations on the significance of death.

If we consider the processes of organic evolution in terms of the properties of living matter we find that certain characteristics have been ascribed to all living organisms, the most important characteristics as generally given in the literature being irritability or excitability, metabolism and reproduction. Other characteristics have sometimes been given, and in the older lists, one usually noted death as one of these general characteristics. Claude Bernard insisted that "evolution is one of the most important traits of living organisms and hence of life." But whether evolution is regarded as a separate and distinct characteristic of living matter, or as the inevitable result of the operation of the other three properties, the physiologist should always keep it in mind in any discussion of general biological problems. Another property of living matter is the power of regulation of its internal conditions.

A living organism has been defined as a vortex (*tourbillon*, Cuvier) of which the direction is constant and which sweeps along molecules always of the same sort, but into which the individual molecules enter and from which they continually depart. As Goodrich has expressed it,[2] "the metabolic process in living matter draws in inorganic substances and force at one end, and parts with it at the other; it is inconceivable that these should, as it were, pass outside of the boundaries of the physico-chemical world, out of range of the so-called physico-chemical laws, at one point to reenter them at another." It is perfectly true that we cannot give an account of all of the changes of matter and energy which occur in living matter, but that is not exactly the same as saying that there are unknown and unknowable processes in living matter which never can be described in terms of changes of matter and energy. And before we can give a final account of the processes of organic evolution, we must be able to tell what are the changes of matter and energy underlying the changes of position and changes of form, which now constitute the greater part of the subject matter of evolution.

THE ORIGIN OF LIFE

The origin of living matter must go back of the origin of cells (Goodrich, p. 16) to the synthesis of organic compounds. But the precise manner of origin of these organic compounds is not for us to consider now. Let it be remembered, however, that the conditions of organic synthesis may not have been greatly different in the former ages of the earth from what they are today (Chamberlin). Further, there must have been a continuous and unbroken series of

[1] Read before the thirteenth annual meeting of the American Genetic Association on December 26, 1916, in New York City.

[2] Evolution, p. 15. London, 1912.

compounds from the earliest organic series synthesized on the earth to the living matter of the present day. The immortality of living matter dates back before the origin of the cell.

Another property or characteristic of living matter must have made its appearance here, since it is present in certain constituents of the environment (Henderson), and that is the property of regulation. I do not mean regulation in precisely the same sense in which it has been used by zoölogists and botanists to denote control of form and size and other morphological characters, but regulation of the physico-chemical conditions of the organism as well. Stability of physico-chemical conditions within certain limits is inherent in the environment, but, as has been shown, the variations may be greater in the environment than in the organism. It is characteristic of some organic compounds, and particularly of those in living matter, that slight changes in the external conditions bring about considerable changes in the compounds themselves. This is the phenomenon of irritability. Some provision for guarding against the effects of such changes on the part of those aggregates of organic compounds which formed the first stages in the evolution of living matter—a power of regulation of the internal conditions—must have been an early acquisition. The known physico-chemical properties of certain constituents of the environment afford us at least some basis for the explanation of the process of regulation in living matter (Henderson). So important for purposes of evolution is this property of regulation that I would consider it as one of the fundamental properties of living matter. We should clearly recognize then, the probability of the early participation of two fundamental properties of living matter—irritability and the regulation of internal conditions—in the evolution of living organisms. Great as have been the advantages to the individual of this property of regulation of internal conditions, its possession also entails certain disadvantages.

CONDITIONS OF LIFE

The survival of any particular complex of organic compounds, and the possibility of its further development to still more complex forms must have been dependent upon various properties, in addition to irritability and the regulation of internal conditions. The ability to form compounds of greater and greater complexity was one. The number of compounds formed, while great and varied, was subject to certain limitations because of the nature and properties of the substances entering into them. The direction of variation was subject to similar limitations, and we may imagine that orthogenesis, in a form dictated by the properties of matter and the conditions in the environment, was operative in the early stages of evolution. Early in the process of evolution, the question of fitness entered in, and we are confronted with the problem of selection. "The principle of the survival of the fittest applies with all its force to such initial steps in the evolution of life. The more completely self-regulating mixtures would outlast the others."[3] It was not many years ago when we read that "the true Darwinism, that is, the tendency which ascribes to natural selection the chief rôle in the origin of adaptations has, in Germany at least, almost no adherents."[4] But whether selection be the chief factor in the origin of adaptation or not, the operation of the principle seems clear in the early stages of evolution, and it is not readily apparent at what point in the process selection has ceased to act.

Whether or not chromosomes existed before the early stages in the evolution of living matter which led to the formation of cells, we do not know, but some of the stages in the synthesis must have been devoid of them. Some degree of heredity must have been possible in these earliest stages by other

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[3] Goodrich, *op. cit.*, p. 17.

[4] "Der eigentliche Darwinismus, d.h. die Richtung, welche der natürlichen Zuchtwahl die Hauptrolle bei dem Zustandekommen der Anpassungen zuschreibt, in Deutschland wenigstens *fast keine Vertreter mehr hat.*" Goebel, quoted by Jensen, p. 3.

means than chromosomes, for the compounds successively arising from the earlier and simpler types must have borne some resemblance to those from which they originated in qualitative and quantitative composition and general deportment. Variation must also have been present, or no evolution would have been possible.

ELEMENTS OF LIFE

It need occasion no surprise to find the primary factors of organic evolution present long before the appearance of the cell upon the earth if we but reflect a moment upon the nature of the fundamental processes or changes occurring in living matter. These are, (1) changes of form, including the visible phenomena of development and growth; (2) changes of position, including the visible phenomena of motility in general; and (3) changes of matter and energy, including all the phenomena of metabolism, and underlying all other changes in the organism. (Jost.) Changes of matter and energy must have been present from the very beginning of the evolution of living matter, since they were present in the inorganic matter from which the first syntheses of organic matter were made. I see no good reason for supposing that any radically new principle has entered in during the course of organic evolution to affect these changes of matter and energy as they are manifested in living organisms.

Herbert Spencer has shown that organisms acquire an independence of the environment. It has been shown that the mechanism by which this independence is acquired is the increasing power of the organism to regulate its internal physico-chemical conditions.[5]

It has been known for many years that the higher animals, *i.e.*, birds and mammals, had the power of regulating the temperature of the body during health. Claude Bernard noticed that the concentration of sugar in the blood remained relatively constant. And as time has gone on, it has been found that more and more of the physico-chemical conditions of the organism are regulated to a great degree of exactness. There is a regulation of the pressure, and of the distribution of the blood, of the osmotic pressure of the body fluids, of the concentration of H and OH ions in the blood (Moore) and, through this, of the activity of the neuro-muscular respiratory mechanism (Haldane). The surface tension of the blood is probably relatively constant in health (Morgan). Not all of these conditions are constant under all external conditions, but variations are in such a direction as will restore the usual condition of affairs. As Haldane expresses it, "Perhaps the most striking fact with regard to physiological phenomena is the evidence they present of activity coördinated in such a manner as to conduce towards the survival of either the individual or the species."[6]

CONSEQUENCES OF REGULATION

Certain consequences for organic evolution of this power of regulation have already been presented in various papers (Woods, Mathews, Pike and Scott). It will be sufficient simply to recapitulate here. Woods[7] has considered some of these consequences from the point of view of the effect of the environment. A clearly diminishing effect may be shown in so far as changes in the environment affect the rate of growth, the external form of the body, and the modification of mental and moral traits, as successively higher types of organisms are considered. The sex ratio in man is very constant over long periods of time and under various social and economic conditions.

It is a possible, and even probable, interpretation to say that the increasing development of the mechanisms—chemical, nervous and muscular—concerned in the regulation of internal conditions has led to the continued presence within

[5] See the writings of Mathews, Claude Bernard, Pike and Scott, Haldane, Henderson, Huxley, *et al.*

[6] Haldane, J. S. Mechanism, Life and Personality (1914).

[7] Woods, Frederick Adams. Laws of Diminishing Environmental Influences. *Popular Science Monthly*, April, 1910.

the organism of a set of conditions which permit of, or even bring about, the optimum activity of the various cells and organs of the body under varying conditions of activity. The organism has been made more efficient.

There are other consequences, however, which should be considered more at length. These are, as I shall attempt to show, (1) the provision of a more favorable environment for the cells than exists outside the organism, permitting differentiation, (2) the possibility of an increased length of life of individual cells without undergoing division, and (3) the limitation of the possible variations occurring in the lifetime of the individual. We may take up the consideration of these various consequences in order.

1. Differentiation is possible in a high degree only when the tissues are protected from external influences. The action of enzymes upon food could not reach its highest point of efficiency if sea water passed through the digestive cavity without restriction. The case is still clearer in terrestrial forms. No such tissue as the nerve tissue of higher animals could be developed if it were continually exposed to the drying action of the atmosphere. The list could be considerably extended.

EFFECTS OF DIFFERENTIATION

But differentiation is accompanied by certain limitations of cell growth which have led some biologists to seek in it the origin of death. The conditions which have made differentiation possible would, on the basis of such a view, also be the conditions which have made the immortality of the Metazoa impossible.

There are certain objections to such a view which have apparently been overlooked. There is no inherent reason why the loss of any one general characteristic property of a cell should be accompanied by the loss of the power to divide. Gland cells in general may have lost the power of contractility, but they still retain sufficient power of cell division to give rise to tumor masses which may invade every region of the body.

Experiments on growing tissues, particularly plant tissues, in artificial culture media have shown that the cells, no matter how specialized, revert to the embryonic type—dedifferentiate as Child puts it—and from this embryonic type go on to reproduce the whole new organism. Cells can be modified if the conditions in which they develop can be modified.

Nerve cells are considered to be highly specialized cells, and their limit of division is reached sooner in ontogenetic development than is the case for other cells. Yet the number of nerve cells has continually increased as successively higher types of animals have appeared. There are more nerve cells in a monkey than in a frog, and more in the human subject than in the monkey. It seems illogical to regard as the reason for the onset of death of the cell, the limitation of cell division in a tissue which is manifesting greater numbers of cell divisions as evolution proceeds.

2. The individual cells in a higher organism in which all the mechanisms of regulation are highly developed may live vastly longer without undergoing cell division than any cells in such a long-lived form as the giant trees of California. The nerve cells in which originate the impulses leading to the respiratory movements do not, so far as I am aware, divide after birth; but from the moment of the first respiratory movement to the last breath man draws at the close of his threescore years and ten, these cells continue to function under all conditions of rest or activity.

3. The limitation of the magnitude of possible changes during the life of any one organism is a direct consequence of the development of a high degree of regulation. This limitation covers the chemical constitution of the organism, since variations beyond certain narrow limits are incompatible with continued existence. The higher organism either maintains its constancy of conditions under all variations of the external environment or dies when an adjustment is no longer possible. There is also a limitation of structural changes. Unrestricted growth of any organ or tissue in the body interferes with the general equilibrium; the efficiency of the

organism is impaired and frequently death results.

HEREDITARY LIMITS

The limitation of changes in the central nervous system in all probability sets a limit to man's achievements during his lifetime. And in no case is a sufficient amount of change possible in the lifetime of any higher organism, no matter how prolonged, to lead to the development of new genera or species.

It is man's nervous system which has raised him above the animals, and on which his progress for the future depends.[8] Limitation of change in this system probably means a limitation of personal achievement, and would mean a limitation of the achievement of the race if no progressive change through the production of new individuals were to occur. Changes of sufficient magnitude for purposes of organic evolution can occur only through the cumulative effects, persisting through many generations, of the small changes, always toward something better if the race or the species is to endure and take its place in the hierarchy of organic life, appearing in each successive generation of new individuals. The immortality of all individuals which have ever appeared upon the earth would have resulted in an insufferable congestion and a ferocity of the struggle for existence which would transcend anything we now know. Ferocity does not seem to be now, nor to have been in the past, the sole object of evolution.

The development of the metazoan body has led to the greater independence of the organism and greatly increased its efficiency. But the coordination of all activity has led to the development of a rigid physico-chemical and anatomical basis in which change is limited during the lifetime of the individual. The restriction of cell division is a necessary consequence of the regulation of body form just as the restriction of changes of chemical constitution is a consequence of the regulation of physico-chemical conditions within the organism. The restriction of cell growth extends even to the germ cells, since uncontrolled development of such cells within the body would lead to disaster exactly as uncontrolled development of epithelial or glandular or connective tissue in malignant growths finally leads to the death of the organism. The germ cells of higher organisms have lost the power of parthenogenetic division, and develop only under such conditions as will decrease, in large measure, the danger to the parent organism. The limitations to possible change during the lifetime of any individual preclude changes of sufficient magnitude for purposes of evolution. The death of the unmodifiable organism may be considered as an adaptation[9] from the point of view of the species.

The Evidence of Evolution

THE THEORY OF EVOLUTION, with special reference to the evidence upon which it is founded. By William Berryman Scott, Blair Professor of Geology and Paleontology in Princeton University. Pp. 183, price $1.00. New York: The Macmillan Co., 66 Fifth Avenue, 1917.

Dr. Scott thinks it is desirable for students beginning work in science to know on what evidence the theory of evolution is based, instead of accepting it meekly as an unquestionable dogma; and in a simple manner he has considered the present status of the question; the evidences from classification, domestication, comparative anatomy, embryology, blood tests, paleontology, geographical distribution, and experimental breeding. The latter chapter is weaker than the others. But as a whole the book is commendable; it ought to be very useful to beginners who want a survey of the whole question, for most of the accepted text-books that are comprehensive are out of date.

[8] See Pike, F. H. Dr. Gaskell's Work on Organic Evolution. *Science*, December 4, 1914.

[9] The idea of death as an adaptation was put forth by Aug. Weismann, on somewhat different grounds than those above outlined, in 1881. His lecture, Ueber die Dauer des Lebens, was printed in 1892 in his *Aufsatze über Vererbung*. See also Gardiner, "Weismann and Maupas on the Origin of Death," *Marine Biological Lectures*, 1890, Boston, 1891, p. 107.

PROTECTIVE COLORATION IN SEEDS OF BOLIVIAN MAIZE

Each Seed Ordinarily Infested by Not More than One Larva—Mottled Seeds Look as if They Had Already Been Entered, and Therefore the Larvae Appear to Discriminate against Them

J. H. Kempton

Bureau of Plant Industry, Washington, D. C.

PROTECTIVE coloration in animals is familiar, but in plants it is not so common. What may be a case of protective marking has been found recently in a shipment of maize from Bolivia.

In a collection of maize secured from the Bolivian exhibit at San Francisco in 1915, through the courtesy of Dr. Otto Buchtien, an ear was found with kernels that had the color of the aleurone cells distributed in a curious mottled pattern strongly suggesting the appearance of self-colored seeds that had been infested with the larvae of the Angoumois grain moth (*Sitotroga cerealella*).

The possibility of this resemblance serving as a protection against the Angoumois moth was immediately suggested. Several investigators have recognized that two larvae do not enter a kernel of wheat or other small grains, but so far as known this fact has not been established for maize. The fact that a single larva completely consumes the contents of one of these small grains may account for the fact that they usually support but one larva. A seed of maize, however, is large enough to provide ample food for two or more, and unless some selection is exercised by the larva many seeds should be found having more than one occupant.

As the eggs of the Angoumois moth are laid in batches of about thirty, the discrimination in the choice of seeds must be made by the larvae.

If selection is exercised it does not seem unreasonable to suppose that the track in the aleurone layer serves as a warning to the newly hatched larva that the kernel already has an inhabitant, and it seems possible that the mottled seed sufficiently resembles the track of a larva to accomplish the same result.

The mottled ear was shelled and the number of infested seeds determined. There were 202 undamaged seeds and 100 with a single larva, but none was found with more than one larva.

As further evidence that larvae avoid seeds already occupied, a census of the self-colored ears from the same collection is shown in Table I. If the selection exercised by the newly hatched larvae were perfect no seeds having more than one inhabitant should be found, while the table shows many such seeds. The number, however, is far short of that which might be expected had there been no selection. Some degree of selection, then, would seem to be a fact, and newly hatched larvae do avoid seeds already inhabited.

If it is admitted that the white tracks left by larvae deter other larvae from entering the seed, it does not appear too fanciful to suppose that the white mottling which so closely resembles the tracks, serve the same purpose. The idea is strengthened by the small percentage of infested seeds and the fact that none was found having two inhabitants. It is, of course, possible that the mottled ear was more favorably situated and hence was not subjected to the same severe attacks. This chance, however, is remote as the remaining ears of many types that occupied the same case were all badly infested.

A comparison of the degree of double infestation on a self-colored ear having all the seeds infested, with the degree

SEEDS OF BOLIVIAN MAIZE

The group at the left is made up of self colored seeds infested by the larvae of the Angoumois moth, whose tracks are conspicuous on the seeds. The group at the right has not been attacked by this larva, but the mottled coloring resembles the tracks of the larvae. It seems possible that this mottling may deceive the larvae; they "think" that the seeds have already been entered and therefore pass on to find fresh fields. Photograph natural size. (Fig. 1.)

TABLE I.—*Percentage of Non-infested, Single-infested and Double-infested Seeds Compared with the Expected Percentage**

Color of ear	Total seeds	Per cent of seeds not infested	Per cent of seeds infested with one larva	Per cent of seeds infested with more than one larva	Expected more than one larva	Deviation	$\frac{D}{E}$
Self	410	26.8	66.0	7.1	19.3±1.31	12.2	9.3
Self	295	33.9	61.3	4.7	15.9±1.44	11.2	7.8
Self	254	1.6	74.8	23.6	34.5±2.01	10.9	5.4
Mottled	302	67.0	33.0	.0	4.4± .8	4.4	5.5

* I am indebted to Dr. Sewall Wright for suggesting the method used to determine the expected number of double-infested seeds.

The formula for calculating the expected percentage of uninfested seeds is $\left(\frac{N-1}{N}\right)^{L}$ and for the percentage of single-infested the formula is . . . $L\left(\frac{N-1}{N}\right)^{L-1} \cdot \left(\frac{1}{N}\right)$ where N = the total total number of seeds and L = the number of larvae. The remainder, of course, equals the number of seeds infested with one or more larvae.

of infestation on a mottled ear, also affords a measure of the effectiveness of the mottled aleurone as a protection. Since all the seeds of a mottled ear have the appearance of being infested the percentage of seeds actually infested should approximate the percentage of double-infested seeds on a self-colored ear having all the seeds infested by at least one larva. These

ears would appear alike and discrimination would be impossible.

One all-colored ear having practically all of the seeds infested is shown in Table 1. The percentage of double-infested seeds on this ear is $23.6 \pm 2.1\%$ while the percentage of infested seeds on the mottled ear is $33.2 \pm 1.8\%$. If this difference is considered significant, it will be necessary to look upon the protection afforded by the mottled color as not quite so effective in preventing initial injury as actual infestation is in preventing double infestation. In other words the mimicry is not quite perfect.

It would be interesting to compare the degree of infestation of mottled seeds with seeds entirely white, but no white ears of the mottled type were present in the collection, and an examination of several importations received directly from Bolivia in previous years revealed no all-white ears of this type.

The moth *Sitotroga cerealella* first attracted attention in Europe in 1728 and is supposed to have reached this country about thirty years later. Of its occurrence in Bolivia nothing seems to be known. The fact that the ancient Incas were accustomed to store large quantities of corn might seem to indicate that the insect was not present. It would appear, therefore, that although mottled seeds may be in some measure protected, it would be quite unwarranted to ascribe the development of the mottling to selection. It must be remembered that the degree of protection which the mottling of the seeds seems to afford may after all be but the result of accident. The resemblance is so close, however, that the possibility of its affording protection seems worth considering. A true test will await an ear having both self-colored and mottled seeds, a combination which is genetically possible.

Experience with Loganberry Hybrids

W. O. Backhouse's remarks on loganberry seedlings (JOURNAL OF HEREDITY, November, 1916), mentioned experiments made by Laxton Bros. in England. Notice in the *Gardeners' Chronicle* (London), evoked a communication (December 23) from Laxton Bros., in which, after stating that they are "substantially in agreement" with Backhouse, they say:

"In the last paragraph you make reference to the Phenomenalberry as being of undoubtedly hybrid origin. We are firmly of opinion that this is nothing more nor less than a seedling from the Loganberry, which it very closely resembles, although slightly larger and sweeter—in fact, the difference is so small to the eye that we do not think we could pick out the plants from the Loganberry unless they were in the fruiting stage. You also figure the Lowberry as being a hybrid between the Loganberry and the Blackberry. We do not think this is a fact. We ourselves have imported a variety under the name of Californian Mammoth Blackberry, from America, which we are unable to distinguish from the Lowberry. We draw your attention to these matters, as when your paper makes authoritative statements they are apt to be quoted in years to come. There are undoubtedly two Rubus hybrids in commerce, namely, the Mahdi (between a yellow Raspberry and the Loganberry) and the Laxtonberry. We have obtained F_2 seedlings from the Mahdi—amongst them a Rubus similar to a yellow raspberry—and the Laxtonberry is a cross between Superlative Raspberry and the Loganberry. Both these hybrids are more or less self-sterile, and require planting amongst other Rubi. We have purchased from Messrs. Veitch the stock of the Veitchberry, which is a hybrid between the Blackberry and the Loganberry. This is not at present in commerce. There have been many seedlings from crosses between the Loganberry and other Rubi, but in nearly all cases self-sterility has prevented them being of any commercial value."

SELF-STERILITY

In Some Cases Where a Plant Cannot Be Fertilized by Its Own Pollen, It Appears That the Pollen-Tube Finds a Very Suitable Medium for Its Food Supply, and Hence Does Not Grow Long Enough to Ensure Fertilization

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SEVERAL who have made a study of the problem of the inheritance of self-sterility of plants have obtained results which did not point to any one definite manner in which flowers act when self-pollinated. In this work the purpose was to try to find some clue to the nature or cause of self-sterility. Several different kinds of plants that had been reported self-sterile were grown, and the stigmas and styles were examined.

In order to avoid confusion, the term "self-sterility" will here be understood to mean that the pollen of a flower is not capable of fertilizing the ovules of that flower, but that the pollen is capable of fertilizing the ovules of another plant and that the ovules of the plant are capable of setting seed when pollinated with pollen from another plant. Thus flowers which have either pollen or ovules which are abortive would not be confused with plants that have self-sterile flowers.

The kinds of plants that were used were Tradescantia, alsike clover (*Trifolium hybridum*), alfalfa (*Medicago sativa*), and the Shirley poppy (*Papaver rhoeas*). The flowers from twelve plants of Tradescantia were used. There were three plants of *T. occidentalis*, and nine that were F_1 generation hybrids from a cross of *T. occidentalis* by *T. pilosa*. On the twelve plants, eighty-three self-pollinations were made, but none of them set seed. Twenty-six cross-pollinations were made, and all of them produced seed.

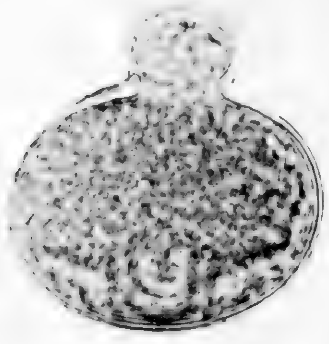
An examination of the styles of twenty pistils that were cross-pollinated showed pollen tubes running to the base of the style. The pistils were examined by crushing under a cover-glass. Then a drop of 1% solution of gentian violet stain was added. The pistil was left in the stain for about one minute, and then the excess of stain was washed off. The pollen tubes could easily be distinguished since they contained many small vacuoles and had no cross walls. The stigmas of the self-pollinated flowers showed good germination of pollen when examined in the same manner; however, the pollen tubes did not grow down the style. The styles of thirty self-pollinated flowers were examined, and the longest pollen tube was found to be 0.5 mm. in length. The style of Tradescantia averages about 5.0 mm. in length. Thus, apparently, the reason for the self-sterility of Tradescantia is due to the failure of the growth of the pollen tubes after germination.

A SIGNIFICANT DIFFERENCE

The significant fact about the pollen tubes from a self-pollination was that they were much wider than those from a cross-pollination. The average diameter of fifty pollen tubes from the self-pollinations was .0216 mm., while the average diameter of fifty pollen tubes from the cross-pollinations was but .0144 mm. The measurements of the pollen tubes were taken as close as possible to the pollen grain. Measurements of the diameter of the pollen

[1] Paper No. 56 of the Department of Plant-Breeding, Cornell University. Read at the thirteenth annual meeting of the American Genetic Association, December 27, 1916, in New York City. The writer wishes to express his appreciation of the many helpful suggestions and useful criticism received from Prof. E. E. Barker.

tubes from cross-pollinations were taken after they had grown down the style; they averaged .013 mm. Thus the width of the pollen tubes in a cross-pollination was nearly constant, being slightly larger near the pollen grain. The largest diameter of a pollen tube in a self-pollination was .028 mm., while the smallest was .016 mm. The largest diameter of a pollen tube in a cross-pollination when the measurement was taken close to the pollen grain was .024 mm., while the smallest was .012 mm. When the measurements of the pollen tubes from the cross-pollinations were taken down the style, the diameters were also .024 mm. for the largest and .012 mm. for the smallest. Thus the greater width of the pollen tubes from a self-pollination is not so great as to cause any mechanical difficulty to its growth down the stylar canal, since the smallest tube from a self-pollination was of the same size as the largest one of a cross-pollination which was measured down the style.



POLLEN GRAIN "BUDDING"

When the pollen grain falls on the stigma of a female blossom, moisture and chemical reactions make it germinate. Part of the contents push their way through a pore in the wall, as shown above in a photomicrograph of sweet-pea pollen by John Howard Paine. (Fig. 2.)

With alsike clover (*Trifolium hybridum*) fourteen different plants were used. There were 1,437 cross-pollinations and 1,452 self-pollinations made on these plants. They were covered with a netting so that the pollinations could not be worked upon by insects. A number of flowers under the screen were left untripped and a number of flowers on plants outside of the screen were left to be open-pollinated. The following table shows the percentages of flowers set in the different pollinations.

	Total No. of flowers pollinated	*No. of flowers setting seed*	*Per cent of flowers setting seed*
Cross-pollinations..	1,437	309	21.50
Self-pollinations...	1,452	40	2.75
Flowers not tripped	3,394	1	0.02
Open-pollinated...	3,480	2,442	70.17

In making a self-pollination the flower was tripped by a pair of tweezers and no care was taken to prevent pollen from one flower in a head from pollinating another flower of the same head. In making the cross-pollinations, the flowers were not emasculated and the pollen from another plant was dusted on to the stigma, using four or five flowers to pollinate a head.

A number of cross-pollinated styles were examined in a similar manner as with Tradescantia, and in all cases there was a large number of pollen tubes growing throughout the length of the style. The styles of forty self-pollinated flowers were examined. There was good germination on all of the stigmas, but on thirty-nine of the styles examined no pollen tubes were found to extend over 1 mm. down the style. In one style of the forty examined, three pollen tubes extended the whole length of the style. This probably accounts for the low percentage of flowers set from the self-pollinations.

With alfalfa (*Medicago sativa*) the flowers from eight different plants were used. The self and cross-pollinations were made in the same way as with alsike clover. The following table gives the number of flowers and the percentages:

	Total No. of flowers pollinated	*No. of flowers set*	*Per cent of flowers set*
Cross-pollinations..	822	318	38.7
Self-pollinations...	1,459	396	27.1

Thus a larger percentage of the flowers was fertilized from the cross-pollinations than from the self-pollinations. From this, alfalfa may be said to be partly self-sterile.

With the Shirley poppy (*Papaver rhoeas* var. *Shirley*), there were eighty-six flowers self-pollinated, using sixty-eight different plants. There were seventy-five flowers cross-pollinated, using seventy different plants. The following table gives the results of the pollinations.

	Average number of seeds set per capsule	*Percentage of flowers yielding 1 or more seeds*
Cross-pollinations....	643.5	84.0
Self-pollinations.....	79.7	39.5

For cross-pollination, the flowers were emasculated about two days prior to the opening of the flower. All flowers were bagged with glacine bags. Since but 84% of the cross-pollinations set seed, it suggests that a number of plants may have been cross-sterile. However, this cannot be definitely stated until the work is again checked up as considerable experimental error may be involved, tests of the germination of pollen on each stigma not having been made. However, on all of the stigmas from cross-pollinations that were examined good germination of pollen was observed.

The species of Tradescantia, alsike clover, alfalfa, and Shirley poppy showed different degrees of self-sterility. Tradescantia was completely self-sterile; in alsike clover about 2% of the flowers set seed when self-pollinated; in alfalfa 27% of the flowers were fertilized with self-pollen, and when the Shirley poppies were self-pollinated 39% of the flowers set seed.

FUNCTION OF POLLEN TUBE

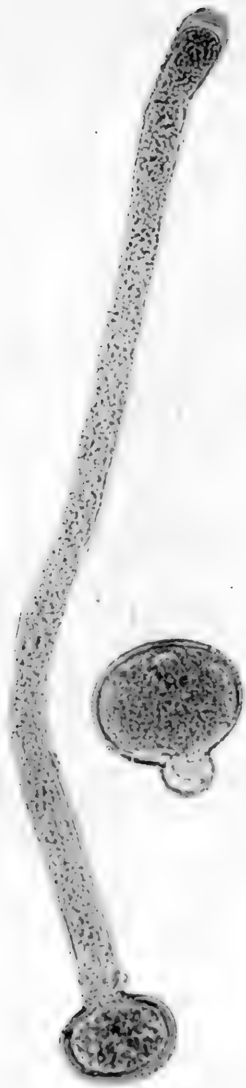
From a morphological standpoint, the pollen tube of the angiosperms has two functions; first, the transferring of the male generative nucleus to the embryo sac, and second, the function of growth which is one of food assimilation. The pollen tubes of the Cycadales of the gymnosperms are much branched and according to Coulter (1910, p. 201) always function as an absorptive organ. They do not have the function of transferring the male nucleus since this cell is a swimming sperm. In the higher groups of the gymnosperms and angiosperms, the nucleus loses the power of motility and the pollen tube has taken on the function of transferring the

THE TUBE GROWS

Constantly absorbing nourishment from the surrounding tissues, the tube grows longer with great rapidity. It may be that its elongation is due to the need of seeking farther for food, and that if the food supply around it is very suitable for assimilation, it will grow wide as in the case of Tradescantia instead of long. This hypothesis has been advanced to account for cases of self-sterility. Photomicrograph by John Howard Paine. (Fig. 3.)

nucleus to the embryo sac. In the manner of assimilating food and growth, the pollen tube acts in a similar manner to the mycelium of a fungus.

Compton (1913, p. 200) has suggested



A LONG TUBE

While the above pollen tube is long as compared with the one beside it, which is just beginning to germinate, it has by no means reached the maximum length. In maize, the pollen grain falls on the end of the "silk" and must grow all the way down that to the seed, a distance of a foot or more in many cases. When it is remembered that the pollen grain is not much larger than a particle of dust, and sometimes can hardly be seen without a microscope, its great capacity for growth will be appreciated. Photomicrograph by John Howard Paine. (Fig. 4.)

that self-sterility in plants may be analogous to wheat which is immune to the rust fungus. The rust fungus is an obligate parasite and when the spore germinates on the host the mycelium penetrates the tissue. In the immune plants the tissue is immediately killed. Since the fungus is an obligate parasite, it cannot grow in the dead tissue of the host and so dies. Thus the plants which are immune are very susceptible to the fungus. When this analogy is applied to self-sterility, it may mean that the pollen tube from a self-pollination is in a more favorable medium for food assimilation. Since the primary function of the pollen tube is to assimilate food, it does not continue to grow at so fast a rate as a pollen tube from a cross-pollination where the medium is not so suitable to it. The pollen tube from a cross-pollination is assumed to continue growth in order to obtain a better food supply.

It is possible to interpret the greater width of the pollen tubes from a self-pollination of Tradescantia in two ways. First, there may be an inhibitor either in the pollen grain or stigma which inhibits the growth of the pollen tube from a self-pollination; and since the pollen tube cannot lengthen itself, it grows wider. Or, second, the food supply may be more favorable and so the tube has not the incentive to prolong itself.

CORRENS' HYPOTHESIS

Taking the first alternative, Compton (1913, p. 203) has shown that the inhibitor hypothesis as put forth by Correns (1912) does not explain the phenomenon of self-sterility. Correns worked with *Cardamine pratensis*, and he assumed that self-sterility was due to two allelomorphic inhibitors, the presence of either being able to cause self-sterility. Correns made crosses between plants which, according to his hypothesis, should have given him four classes of progeny, one of which should lack both inhibitors and so be self-fertile. However, all of the plants were self-sterile, so that the experimental evidence obtained by Correns did not confirm the hypothesis.

East (1915, p. 85) suggests that the

action of the stigma to a pollen tube from a cross-pollination may be different from that to a pollen tube from a self-pollination. He states that "all gametes having in their hereditary constitution something different from that of the cells of the mother plant, however, can provoke the proper secretion to stimulate the pollen tube growth, reach the ovary before the flower wilts, and produce seeds." From this it may be inferred that there may be an enzyme in the pollen grain that in a cross-pollination is able to induce the stigma to excrete a stimulating substance so that the pollen tube is able to grow. In a self-pollination this enzyme is not able to act. However, if this were the case, when a few cross-pollen grains were placed on a self-pollinated stigma, they would be expected to germinate and cause the stigma to produce the stimulating substance. Thus the pollen tubes from the self-pollination would also benefit by the stimulating influence and should be able to grow and bring about fertilization. However, the work with alsike clover does not support this hypothesis. It must be assumed that if any pollen tubes were able to grow that it was due to this stimulating influence. As a fact, three pollen tubes from a self-pollination of alsike clover grew throughout the length of the style while the other tubes remained short. If this enzyme hypothesis were to be accepted, the same stimulus which made the three pollen tubes grow should also have made the other pollen tubes grow.

EFFECT OF FOOD SUPPLY

The second alternative may be taken, namely, that the greater width of the self-pollinated pollen tubes of Tradescantia is due to the fact that the food supply is more favorable to the nourishment of a self-pollen tube than it is to a cross-pollen tube. On account of the abundant food supply the pollen tubes did not lengthen, but grew wider since they were in a very favorable medium. By this hypothesis it is possible to explain most of the data here presented in regard to self-sterility, and it is not contradictory to any cytological evidence. The Shirley poppy results showed that a small proportion of the plants were probably cross-sterile. However, this is only reasonable since if a large number of plants were used, a few of them would be expected to have nearly the same kind of food supply and so be cross-sterile. East (1915, p. 81), working with *Nicotiana*, and Stout (1916, p. 384) with *Cichorium intybus* also found a small percentage of plants to be cross-sterile.

Thus the hypothesis suggested by Compton (1913, p. 200) that self-sterility in plants may be analogous with wheat which is immune to the rust fungus, seems very probable. Briefly, the main evidence favoring such an explanation is as follows: (1) The primary function of the pollen tube is to obtain food. (2) The method of obtaining food and manner of growth are similar to a fungus. (3) Pollen tubes of self-pollinations of Tradescantia were about one-third wider than those of cross-pollinations. (4) If a number of pollen tubes grow throughout the length of the style, other pollen tubes in that style may remain short. However, this explanation is only tentative, and much more data should be obtained before it can be held that this is the correct solution.

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COEDUCATION AND EUGENICS

Women Graduates of Syracuse University Have Very Low Marriage and Birth Rates—Those of Men Graduates Are Much Higher—Colleges Perhaps Receive an Abnormal Type of Woman and Nature of Education Can Effect Little Change in her Unmarriageable Character.

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WHILE considerable work has been done recently in the statistical study of the fecundity of college graduates there are still some phases of the subject for which the facts and figures have not been fully presented. Most of the work heretofore has been based on the records of the separate colleges for men and women and, aside from some data as to marriage rates, no extensive study has been made of any coeducational institution. To supply this deficiency the writer undertook nearly a year ago a compilation of the statistics of Syracuse University, but has been delayed in publishing the results by the press of other work.

The finding of previous investigators has been, in general, that college graduates show a declining rate of fecundity to a point where they are not even reproducing themselves, and that the record for the graduates of women's colleges is by far the lowest. This has led to severe animadversions upon the "atmosphere" of the separate college for women with strong intimations that coeducational schools would render a much better showing. The work here presented was undertaken with the expectation that it would furnish confirmatory facts for so plausible a theory. If the figures have failed to sustain the claims for coeducation it cannot be charged that it is due to any bias on the part of the compiler. The results obtained seem to demand a theory of selection which has been recently intimated but not presented definitely as an explanation of the low birth rate seemingly fostered by the higher education of women.

The tables here presented are condensed summaries of more elaborate statistics. The work has been based on the *Alumni Record and General Catalogue of Syracuse University* edited by Dean, now Vice-Chancellor Emeritus, Frank Smalley, an elaborate work in two volumes published in 1911. The period covered by the statistics is exactly fifty years from 1852 to 1901, inclusive. It is obvious that later figures would be of doubtful value. In fact even the data recorded for the decade 1892–1901 should be used with some caution as in the later classes of this decade there may be some children and even a few marriages not yet recorded. We feel confident, however, that these will never materially affect our conclusions and will scarcely produce an appreciable effect in the averages. We have the records for ten years a ter the graduation of the last class while the average interval from graduation to marriage is for the men 4.5 years and for the women 4.7 years.

EARLY HISTORY OF SYRACUSE

Why the statistics are carried back to 1852 while the University is commonly understood to have been founded in 1871 may need some explanation. Prior to 1871 the institution had existed as Genesee College at Lima, N. Y., having been a coeducational school from the beginning and with the same collegiate ideals. In the latter year faculty and students were transferred to the city of Syracuse and reorganized as Syracuse University, the alumni of the old college being formally granted degrees from Syracuse in order to obviate any question as to their legal standing in the new institution.

The tables here published have been compiled separately for the men and the

women, and have been arranged by decades, this being a convenient period of time and also permitting the segregation of the statistics for the two phases of the institutional life, the first two decades covering Genesee College and the last three belonging strictly to Syracuse. It is evident that at the time of transition there is no marked differentiation in the statistics, a fact which confirms our belief that there was no essential break in the continuity of the institutional life.

In compiling the figures only those students who graduated in liberal arts courses were considered. Figures for non-graduates would be interesting for comparison especially in the case of the women, but the records do not give the later history of this group. The restriction to liberal art work seemed necessary in order that the results might be comparable with statistics previously published for men's and women's colleges. Prior to 1873 there were no fine arts students, but after that date they increased rapidly, and it must be remembered that in the last two decades covered by our figures there was a considerable body of women in fine arts work, many of whom became the wives of the men in the liberal arts college. This has bearing on one of our categories as will be seen later.

STUDENT BODY HOMOGENEOUS

Naturally the first comparison to be made is between the two tables. In this case we have two populations differentiated in only the one factor of sex. Both men and women were drawn from the same social strata. This was particularly true of the liberal arts college. There were students of both sexes from homes of wealth, at least sufficient to provide for all their necessities; there were some in straitened circumstances demanding close economy; and there were yet others really struggling with poverty. In each class there were apparently as many women as men in proportion to the total number of each in the college, so far as one could judge who was intimately acquainted with the student life of the institution. The college environment, at least in the last two or three decades, was absolutely uniform. The students of both sexes roomed largely in private houses in the vicinity of the college or in a few fraternity club-houses and took their meals at private boarding houses or students' clubs. There were no dormitories, no matron or dean of women, and the young women were under no more surveillance as to conduct and social liberties than the young men; for many there was doubtless a larger liberty in social life than they had been permitted to enjoy at home. The two sexes met in the same classrooms, heard the same lectures, and recited in each other's presence.

The first point to be considered in a comparison of the two sexes is the proportion that marry. In the earlier decades the numbers involved are so small that considerable variation in averages or percentages is probably of no great significance. Both sexes seem at first to have maintained a nearly equal frequency of marriage, but in the later decades there is a remarkable falling off in the percentage of women who marry, and, for the whole period, we have only 57% of the women as compared to 81% of the men. The significance of this, if any, we will leave for later discussion.

The next item in the table, "Average age at marriage," need detain us but briefly. There appears nothing peculiar about it. The women average about a year younger than the men and the figures appear remarkably uniform especially for the young men. In view of the fact that during the period covered the amount of preparation required of young men for professional life has steadily augmented, it seems remarkable that there has not been an advancing average age at marriage. This has commonly been predicated, but our figures do not support the hypothesis. They sustain the deductions of Phillips as to similar conditions at Harvard and Yale.[1]

[1] Phillips, John C. A Study of the Birth Rate in Harvard and Yale Graduates. Harvard Graduates Magazine, 25: 25–34. Reprinted in part in the JOURNAL OF HEREDITY, 7: 565–569.

The next subject is of special interest as viewing from a new angle that perennial question whether the coeducational institution fosters matrimonial tendencies. This question takes the form, what percentage of the students of either sex who marry have presumably made the acquaintance of their future consorts through the influence of the college associations, or, as expressed in the table, have "married within the college." In view of the opinion so largely prevalent, especially in the early days of coeducation, which led the opponents of that movement to the use of the derogatory term "match factory," it is surprising to find that less than one-fourth of the marrying men (less than one-fifth of all male graduates) married women of the college. In the earlier days the proportion was far less. It is interesting to note that the percentage of men marrying fellow-students steadily increases with each decade. This appears to be accounted for in part by the fact that there is a constantly increasing group of women available for selection. But, as we shall see presently, this conclusion must be drawn with some caution.

Turning our attention to the statistics for the women we meet with a surprising contrast. First, there is the much larger percentage of women than of men who marry fellow-students. The difference is even greater than appears from the returns, for not only are there women who marry and fail to graduate, but also we must remember there was a considerable body of women in the fine arts college, especially in the last two decades, who are excluded from our statistics for the women but, being members of a common social group, marriages with these are accounted in the table for men as "within the college." The explanation most readily offered for this contrast is that the total number of women in the institution is much less than that of the men, hence affording a smaller field of selection for the one sex than for the other. This may be an important factor in the earlier decades and, combined with the small total attendance then, may be a sufficient explanation. But it seems hardly adequate to account for the high percentages in the later decades when the total attendance of women, including the fine arts school, was not only large but equaled or exceeded that of the men. In 1872 there were in the college 26 women and 82 men; in 1882, 129 women and 154 men; in 1892, 321 women and 247 men; and in 1900, 500 women and 506 men.[2]

WOMEN'S MARRIAGES DECREASE

The second surprising feature in this part of the table is the fact that in the last four decades there is a steady decline in the percentages for the women. If the increase of marriage within the college group on the part of the men seemed accounted for by the increased size of the social group and consequent larger field for marriage selection, how shall we account for this precisely reversed result on the part of the women under the same condition? It is not clear that this is at all correlated with the general decline in per cent of marriages, for these last figures are the per cent of married women, not of all women. It may be suggested that while the absolute number in the social group is increasing the ratio of men to women is decreasing, thus rendering the field of selection for the women relatively smaller though absolutely larger. In this case the explanation of the phenomenon is chiefly statistical. Without corresponding data from other coeducational schools further discussion of the matter would seem to be profitless.

We now come to the last six columns of the tables which have to do specifically with the fecundity of the graduates and survival of offspring. Children were accounted as surviving unless known to have died under the age of twenty. This age was selected as approximating independence of parental care. Since there is no uniform practice as to what constitutes "survival," comparison on this point with the findings of others is impracticable. In the original tables the proportion of the sexes in the

[2] Annual Catalogue, Syracuse University.

offspring was determined, but as there appeared to be nothing of significance in the results they are not reproduced here. It is not necessary to enter into further discussion of the details of this part of the tables as the figures are sufficiently clear. By whatever method the facts are measured it is evident that for both sexes there is a steady decline in fecundity from the earlier to the later years. This is in strict conformity with the findings of others as to other institutions, coeducational and non-coeducational, for men or for women, and has been shown to be true also of non-college populations.[3] There appears no reason to believe that this decline is induced by any influence within the college. The factor or factors are more broadly social and the college, any college, is only a phase of the larger problem. It is, however, to be noted from the tables that the married college women under precisely the same educational conditions as the men are reproducing in a distinctly less degree, and this, combined with the lower marriage rate of the last decades, gives a total reproductive rate for all the women graduates of only about half that for the men. It seems conclusive that college-bred women under the same environmental influences are much less reproductive than college-bred men, and by inference are much less reproductive than non-college-bred women of the same social rank, *i.e.*, the wives of college men; for since some college men marry college graduates the task of maintaining the higher average for the men falls chiefly on the non-graduate wives.

INFLUENCE OF COEDUCATION

In view of the facts presented it seems highly probable that Johnson and Stutzmann[4] have erred in their explanation of the low birth rate revealed by their studies of Wellesley College. The conditions at Syracuse seem to have provided nearly everything which these authors found lacking at Wellesley and the figures for the two institutions conform with most surprising closeness. The data for Wellesley are for the classes 1879–1888. The period in our tables most nearly approximating this is the decade 1882–1891. To show the remarkable conformity we reproduce them.

	Wellesley	*Syracuse*
No. of children per graduate	.86	.88
No. of children per married graduate	1.56	1.60

We do not, however, lay great stress upon the closeness of these figures, which are doubtless in some degree a coincidence, but our whole table clearly shows that there prevails at Syracuse the same low birth rate that was found at Wellesley. The results suggest very strongly that we have to deal here with a cause that is not peculiar to this or that college but is in fact very general. Like the decline in birth rate already noted it perhaps pertains to a social group of which the college life is only a phase. Nevertheless, the fact that the college woman in the same educational environment displays such a decidedly and persistently lower reproductive tendency than her brother suggests that there is some special sex reaction to the college environment. Is it not probable that the college curriculum of the past as presented to the women, whether in the coeducational or separate college, has had the effect of segregating from the general population on the average the non-reproductive type of woman? In other words the college environment, whether social or intellectual, whether in its ideals or its discipline, has not so much perverted or suppressed the distinctively female instincts as it has failed sufficiently to appeal to them. As a consequence the women who enter upon the regular college course and carry it to completion are on the average—for there are many exceptions—more or

[3] Smith, Mary Roberts. Statistics of College and Non-college Women. American Statistical Association Publications, 7: 1.

Engelmann, George J. Education not the Cause of Race Decline. *Popular Science Monthly*, June, 1903.

[4] Johnson, Roswell H., and Stutzmann, Bertha J. Wellesley's Birth Rate. JOURNAL OF HEREDITY, 6: 250–253, 1915.

less lacking in the normal sex instincts. The college has been the means of selecting from the general population the less normal type. This conclusion seems to be confirmed by the discovery of Johnson and Stutzmann that Wellesley women who do not graduate have a higher birth rate than those who do, that is, they approach more nearly to the norm, while those who attain to the highest intellectual honors, Phi Beta Kappa, Durant and Wellesley scholarships, yield the lowest birth rate or are farthest from the norm. Professor Cattell, as cited by those authors, finds also that the wives of American men of science are on the average prolific in reciprocal proportion to the degree of their college attainments. We regret that the Syracuse records did not furnish data for further evidence on this point.

NO CAUSE FOR ALARM

If our reasoning is correct, are we not unduly alarmed at the eugenic disaster which seems to threaten from the low birth rate of this supposedly superior class of women? It is doubtful if they are a superior class except in a strictly limited sense—often a purely intellectual superiority. In reality they represent a highly specialized class of low fecundity, a severely selected type, as Johnson has pointed out, but not well selected for the foundation of a great racial stock from a eugenic standpoint. They are of great value to society in their way and deserving of having their fine qualities developed to the utmost and utilized in the needs of society. For many of them, doubtless, the college courses heretofore offered are well adapted and have been the means of bringing to fruition the socially valuable qualities which they possessed. It is not to be supposed that a different type of college training would have been desirable for them, nor is it evident that any other form of education would have increased their reproductiveness materially. On the contrary, many would have become restless under the system and would have sought relief in some atmosphere that appealed more to their purely intellectual aspirations. But the college should also provide for the needs of their sisters whose domestic and motherly instincts seek equally if less obtrusively the opportunity for full development and expression. The result would not be to increase the reproductive qualities of that type of woman which the higher education has heretofore cherished, but would attract to a higher education the type of woman which is naturally more reproductive. These normal, "all-round," "red-blooded" women are the really superior type and the college should provide a course of training attractive to their instincts and intended to develop all their innate powers and capacities to the highest efficiency.

Since this paper was ready for the press the marriage rates for coeducational institutions recently published by the editor of the JOURNAL[5] have come to my attention and seem to give some additional support to this view. For the institutions yielding the highest marriage rates are state schools that make much of courses in applied science adapted to the interests of home builders and social efficiency. Syracuse and Stanford, more closely confined to the classics, humanities, and pure science, present figures so nearly identical for the same period as to be, the editor remarks in a private letter, "uncanny."

There remains for discussion the comparison of our tables with similar tables compiled for other institutions such as the work of Dr. John C. Phillips on Harvard and Yale students[6] and Prof. Robert J. Sprague's figures for

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[5] Stanford's Marriage Rate. JOURNAL OF HEREDITY, viii, pp. 170–173, April, 1917. See also Coeducation and Marriage. JOURNAL OF HEREDITY, viii, pp. 43–45, January, 1917. Stanford and Syracuse are at opposite sides of the continent; the marriage rate of their graduates for the last decade of the nineteenth century is as follows:

	Men	*Women*
Stanford	73.2%	48.5%
Syracuse	72.7	48.6

[6] Phillips, John C. *Op. cit.*

TABLE I.—*Women Graduates of Syracuse University*

Decades	Average number of graduates per class	Average number married per class	Per cent of graduates married	Average age at marriage	Average number marrying within college per class	Per cent of married marrying within college	Per cent of married childless	Per cent of graduates having 2 or more children	Average number of children		Average number of children surviving	
									per married	per graduates	per married	per graduates
'52–'61	1.5	1.3	87	25.8	.5	38	8	60	2.31	2	2	1.73
'62–'71	3.1	2.7	87	26.4	1.7	65	11	59	2.26	1.97	1.93	1.68
'72–'81	3.6	2.9	81	30.9	1.5	52	31	34	1.62	1.31	1.31	1.06
'82–'91	6.9	3.8	55	27.8	1.7	45	26	50	1.60	.88	1.45	.79
'92–'01	25.1	12.2	48	27.6	4.9	40	34	34	1.12	.54	1.07	.52
Totals	8.04	4.58	57	27.7	2.06	45	28	42	1.46	.83	1.31	.75

TABLE II.—*Men Graduates of Syracuse University*

Decades	Average number of graduates per class	Average number married per class	Per cent of graduates married	Average age at marriage	Average number marrying within college per class	Per cent of married marrying within college	Per cent of married childless	Per cent of graduates having 2 or more children	Average number of children		Average number of children surviving	
									per married	per graduates	per married	per graduates
'52–'61	6.8	5.5	81	28.2	.7	13	5	63	3.29	2.66	2.62	2.12
'62–'71	9.1	7.9	87	28.4	1.2	15	14	71	2.51	2.18	1.95	1.69
'72–'81	16.4	14.8	90	29.1	2.7	18	14	55	2.30	2.08	1.96	1.77
'82–'91	22.4	18.9	84	29.5	4.4	23	21	50	2.17	1.83	2.04	1.72
'92–'01	36.6	26.6	73	28.9	8.3	31	27	31	1.46	1.06	1.38	1
Totals	18.3	14.7	81	28.8	3.46	24	20	45	2.06	1.66	1.82	1.47

the women's colleges,[7] etc. These may be disposed of briefly for our results simply confirm the findings of others in all essential facts. The most striking difference to be observed is the much higher percentage of married men at Syracuse than at either Harvard or Yale. At first thought one would say it is the influence of coeducation. But Wesleyan and Amherst, both non-coeducational institutions, are shown by Professor Hall[8] to have each a higher marriage rate for the same periods than even Syracuse. Comparing the women's table with the statistics of women's colleges as reported by Professor Sprague we find only that the marriage and the birth rates of Syracuse women are distinctly lower than those of Mount Holyoke, higher than for Bryn Mawr, a little less than for Vassar, and about the same as at Wellesley. We are disposed to think that these differences, so far as they are sufficiently large to have any significance, are simply indexes of the ulterior social group to

[7] Sprague, Robert J. Education and Race Suicide. JOURNAL OF HEREDITY, 6: 158–162. 1915.

[8] Hall, G. Stanley, and Smith, Theodate L. Marriage and Fecundity of College Men and Women. *Pedagogical Seminary*, 10: 275–314. 1903.

which the student body pertains. The factor of coeducation appears to have produced no specific influence, nor is there clear evidence that the college environment has materially affected the results. The problem is to a considerable degree one of inherent character of the women, in which the college has served chiefly as a selective agent for a specific type.

The Problem of Handedness in Education

Approaching the problem of left-handedness from the psychological side, Prof. W. F. Jones, of the University of South Dakota, described his researches at the last meeting of the American Psychological Association.

Out of 10,000 persons 417 are born left handed, 9,853 are born right handed; 4% of the race are lefthanded, 96% are right handed. Out of 417 born left-handers, 323 shift to the right hand. Seventy-seven per cent of born left-handers adopt the minor arm. Out of 417 born left handed, 4 are shifted by accident, 1% of all lefthanders; 319 are shifted by purposive interference; 94 are allowed to use the major arm. Out of 9,583 born righthanders 96 are shifted to the left hand, 1% (accident). Four hundred and nineteen persons (323 plus 96) out of 10,000 adopt the wrong arm, that is, one person out of twenty-five is using the minor arm.

Conclusion from skill tests of the three types of handedness are: (1) The pure lefthander reveals no less skill than the pure righthander; (2) the shiftover is regularly deficient in hand and arm skill; though the average skill of his two hands is equal to the average skill of the two hands of the right or lefthander, he has two minor hands and arms rather than one dextral and one minor; (3) it is possible to shift back to the major arm if the shiftover does not show a muscle swell of minor arm exceeding that of the major (born) arm, and if the shiftover is below adolescence the backshift should be made. His work agrees in general with that of other students.

The Offspring of Marriages of the Deaf

GRAPHICAL STUDIES OF MARRIAGES OF THE DEAF IN AMERICA, by Alexander Graham Bell, with an introduction by Fred DeLand. Pp. 300. Washington, D. C.: The Volta Bureau, 1917.

In his book, "Marriages of the Deaf in America," published in 1898, E. A. Fay recorded data about 2,644 marriages where children had been produced, and where one or more of the parents was deaf. Dr. Bell has made a graphical representation of each of these cases, and pedigree charts of the 300 cases in which there were deaf offspring. The dysgenic effect of the marriage of deaf persons can therefore be seen at a glance. It is found that the average number of children is 3.48, and that 56% of them are deaf. This, however, refers only to marriages which resulted in at least one deaf child. Most of the marriages, in which at least one of the parents was deaf, did not result in deaf offspring. Of the total number of children (6,782) from all marriages, only 588 or 8.6% were deaf.

A Horseman's Views on Eugenics

"The Right To Be Well Born" is the title of a book lately published by W. E. D. Stokes, president of the Patchen Wilkes Stock Farm, Lexington, Ky. Mr. Stokes is one of the best-known breeders of thoroughbred horses in the United States, and believes that many of the methods which have been successful in that industry could be profitably applied to the human race. His book is one of the most original and thought-provoking of recent contributions to the literature of eugenics and should have a stimulating influence.

HIDDEN FEEBLEMINDEDNESS

One Person in Fourteen of the American Population Probably Carries the Trait in a Recessive Form, Although Normal to all Appearances—One-Fourth of Offspring will be Feebleminded if Mating is Made with Another Carrier

E. M. East
Bussey Institution, Forest Hills, Mass.

THE increase in the number of feebleminded in the United States during the past few years has been such that the heredity of the trait, and the classification and treatment of those so afflicted, have been the subject of much careful study. The result of this activity has been very creditable. Thanks to the researches of Goddard, the method of inheritance of feeblemindedness is as clear as that of any other heritable variation in the human race. Owing to the ingenious psychological methods of Binet and Simon, the grade of mentality can be determined reasonably well. Even our slowly moving legislative bodies have been somewhat disturbed by the facts and have passed a considerable number of laws designed to cut off this defective germplasm, either through segregation of the sexes during the reproductive period or by sterilization.

One can have only words of commendation for the serious efforts to face the problem; nevertheless, in the numerous papers on feeblemindedness that have been published during the last decade, not a single author appears to have appreciated the real menace. Our modern Red Cross Knights have glimpsed but the face of the dragon.

Goddard has shown that feeblemindedness is transmitted as a Mendelian recessive. In other words feebleminded individuals may be produced in three ways. If feebleminded mates with feebleminded all of the offspring will be feebleminded. If a feebleminded individual mates with one carrying the trait in his or her germcells, on the average one-half of the offspring will be feebleminded. It is these two types that segregation or sterilization will affect. But these are not the only sources of feeblemindedness, and perhaps they are not the most dangerous. If two carriers of feeblemindedness mate, one-quarter of their offspring will exhibit the trait and one-half of them will transmit it. Let us endeavor to see what this means.

THE NUMBER AFFECTED

It appears that in our present population of 100,000,000 or thereabouts, there are 300,000 persons who are feebleminded through an hereditary defect, a ratio of 3 per 1,000. This is an estimate to be sure, but it is so conservative that it probably veils the true state of affairs.

Now how many of these defectives have been the result of a mating wherein at least one of the parents was feebleminded? This question is a difficult one and can only be answered with a rough approximation. The best estimate that I can make from a careful examination of the meagre statistics at present available is 100,000. The dose must not be too bitter, however, so let us double this estimate. This leaves 100,000 feebleminded persons that must have been produced by the mating of two transmitters of feeblemindedness who did not show defective mentality themselves, unless an unprecedented percentage of origin *de novo* be assumed.

These 100,000 defectives were produced during a period in which there were rather less than 20,000,000 married couples of reproductive age. They were produced by parents both of which carried feeblemindedness. But only

one-fourth of the progeny of such matings show feeblemindedness. Therefore, at least 100,000 couples of this type were reproducing during this generation. This would presuppose the survival of four children per couple long enough to have their mental status determined, an assumption that would probably require a total reproductivity of seven children per married pair. Among the children from these matings would be some 200,000 carriers of defective germ-cells, but we will omit them from our considerations. The important point is that out of 20,000,000 pairs of married persons, if we treat the problem as static, 100,000 were transmitting feeblemindedness. What then is the number of such persons in the population?

Let us state the question in another way. A certain number of persons out of a population of 40,000,000 of a marriageable age have defective germ-cells. If two of them marry, one-quarter of their children will be feebleminded. If 100,000 of such marriages did occur, what is the ratio of carriers of feeblemindedness to normals in the general population? The correct answer will depend of course upon how much selective mating takes place. There is unquestionably a general tendency for carriers of feeblemindedness to be brought together and a marriage to result. But this cannot be taken into account very accurately and had best be left out of our calculations.

Pairing among carriers of feeblemindedness has occurred in the ratio of 1 to 200 marriages; then, if no selective mating has taken place, carriers of feeblemindedness must occur in the general population in the ratio of 1 to 14.

One-fourteenth is approximately the square root of $1/200$. If $1/14$ of the population carry feeblemindedness and $13/14$ are normal, then the probability of normal mating with normal is $13/14 \times 13/14 = 169/196$, the probability of normal mating with carriers of feeblemindedness is $1/14 \times 13/14 + 13/14 \times 1/14 = 26/196$, and the probability of two carriers of feeblemindedness mating is $1/14 \times 1/14 = 1/196$.

Possibly this figure is somewhat too high for the single trait feeblemindedness. We have not corrected for changes in the population during the length of the period considered or for selective mating. But, to balance this we have used a low estimate of the number of feebleminded, a high estimate of the number of defectives produced by parents of which at least one exhibited defects, and a high birth-rate in families of those transmitting the defect. Further, no mention has been made of epilepsy and of certain types of insanity, which are inherited in the same way, and to which the same line of reasoning applies. In view of these facts it is probable that the conclusion that 1 person out of every 14 carries the basis of serious mental defectiveness in one-half of his or her reproductive cells understates rather than overstates the facts.

The problem of cutting off defective germ-plasm, therefore, is not the comparatively simple one of preventing the multiplication of those so affected. This task, though sufficiently difficult in practice, is possible: the way has been pointed out; something has been accomplished. It is rather the almost hopeless task of reducing the birth-rate among transmitters of serious defects.

NEED FOR RESEARCH

A stupendous task necessitates prodigious efforts. Already there is a tremendous selective birth-rate in favor of lesser civic worth, and it is extremely doubtful whether, under our present economic system, much can be accomplished by recommending early marriages and large families among those whose accomplishments have proved their social value. Whether family limitation among those carrying defective germ-plasms can be effected must be decided in the future. It will be a distant future if a stupid government persists in refusing to countenance rational parenthood among those least fitted to reproduce the race, the while shutting one eye and winking the other at what has become a national practice among those best fitted to build a

greater America. There is one suggestion, however, at which no one will cavil. We have assumed that a normal mentality is completely dominant over a defective one. Is this true? Complete dominance is rare among those characters commonly studied by animal and plant geneticists. Is it not likely that the Binet-Simon or other proper tests would show that carriers of mental defects exhibit a lower mentality than pure normals? Would it not be wise to start some investigations along this line?

Marriage Rate of Iowa State College Women

In the JOURNAL OF HEREDITY for January, 1917, are brought together figures of several western co-educational colleges, showing the proportion of married women graduates in comparison with certain eastern women's colleges. The figures here added are for Iowa State College, as taken from the Alumni Directory issued June, 1916. During the period from 1872 to 1905, inclusive, 315 women graduated, and 229 of these, or 72.7%, married. During the five-year period 1900–1904, 39 out of the 56 women graduates married, or 69.6%. For both periods, the figures are higher than for any other college given. Earlier and later periods compared as follows:

Period	*Per cent married*
1872–81	95.8
1882–91	62.5
1892–01	71.2
1902–06	69.0

The decline is not regular, as for some reason the second decade shows the lowest record. But even this is high compared with eastern figures. The rather remarkable fact appears from the record of the first nine classes that graduated, from 1872 to 1879, and also that of the class of 1885, that all of the forty-eight women graduates of these ten early classes married.

J. C. BLUMER, *Tucson, Ariz.*

The Lethal Factor in Yellow Mice

Yellow mice are familiar to fanciers, but none has been found which breeds true. This has been explained by the assumption that all living yellow mice have received their color from only one parent. If a mouse receives yellow from both parents, it is supposed, he receives necessarily, at the same time, a lethal factor which prevents development of the embryo; or technically, the homozygous zygotes which should heoretically exist are for some reason not viable. All breeding facts bear out this hypothes s, nor is this the only known case where a lethal factor seems to be inherited, which prevents the development of all individuals with a certain genetic constitution. But it has been desirable to have embryological evidence, and Prof. W. B. K rkham, of Yale, reported on it at the last meeting of the American Society of Zoölogists. He found that many degenerated embryos resulted from every mating of yellow mice, but only a few when other colors were mated. The hypothesis that a double dose of yellow coat-color means death for the embryo that receives it, is therefore substantiated to some extent.

The Cost of Defectives to the Nation

The annual cost of the socially inadequate in the United States is approximately $100,000,000, according to the Eugenics Record Office, which has recently completed a survey of the subject. The States pay out every year $73,000,000 for the support of their defectives, degenerates and delinquents, and the counties, municipalities and private institutions account for the other $27,000,000. This hundred million dollars of annual expense represents a part of the price paid for lack of eugenics; but it is only the direct price. The indirect one is much larger. Details will be published by the Census Bureau.

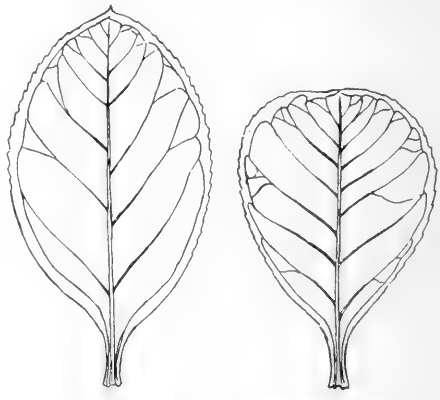
A BUD VARIATION OF EUONYMUS

A. D. Shamel, *Riverside, Cal.*

THE accompanying photograph (Fig. 5), shows a small limb of *Euonymus japonicus*, an evergreen shrub, belonging to the family Celastraceae.[1] The leaves of this species are normally rounded ovate. The margins of the leaves are toothed. The color of the foliage is a deep green. The small pale green flowers are composed of four petals, are usually borne two to five together on a stalk in the axils of the leaves, and are succeeded by top-shaped seed-vessels of three blunt lobes, and as many cells, each containing a solitary seed. In Southern California during the winter months these fruits become more conspicuous among the leaves by assuming a pink color which makes them highly ornamental. The lobes of the capsule, finally assuming a bright rose color, open at a projecting angle and disclose the seed wrapped in an orange-colored arillus. The foliage, flowers, and fruit are said to be poisonous, but the fruits are sometimes used as a dye. The wood, which is of a light yellow hue, being strong, compact, and easily worked is applied in some countries to many useful purposes; *e. g.* skewers, pegs for shoes, spindles, etc. The charcoal made from the young shoots is used by artists on account of its smoothness and ease with which it is erased.

In Southern California this shrub is highly prized and commonly used for ornamental plantings, sometimes for hedges and otherwise for individual shrubs. Eight or more varieties of this species are propagated commercially by California nurserymen. Of these *E. japonicus argenteo-variegatus* (Silver variegated Euonymus) is the one most commonly found in the gardens and other ornamental plantings in the vicinity of Riverside. This variety, on account of its variegated foliage, the silver-like margins and irregular stripes of the leaves, is very striking in appearance even from a considerable distance. The shrubs have an upright habit of growth. It was developed from branch variations of *E. japonicus*, an example of which is shown in the accompanying photograph.

In the variegated form the leaves differ from the ordinary form particularly as regards shape and color. The shape of the ordinary leaf is ovate with an obtuse apex. The shape of the variegated leaf is obovate and the apex is usually truncate or retuse. (See Fig. 6.) The margins of the leaves of the ordinary form are usually serrate, while the serrations of the variegated leaves are much less marked, so much so in some cases as to be almost invisible without very close inspection.



CHANGE IN LEAF FORM

At the left is the ordinary leaf of Euonymus, at the right the leaf of the variegated form. It is evident that the same bud variation which produces the change in color, also produces changes in numerous other features. (Fig. 6.)

The color of the ordinary leaves is a uniform deep green, slightly deeper in shade on the upper than on the under

[1] The Treasury of Botany, part I, p. 475.

THE ORIGIN OF A VARIETY OF EUONYMUS

On this green shrub, part of a branch has become variegated, due to some internal change which has affected the pigment. But internal changes of this sort are apparently never confined to a single character. Not only is the color of the leaves changed, but their shape is likewise altered, and the difference in appearance extends to the stem. Changes of this sort are rather common, and probably have not much importance in normal evolution, but they are sometimes of much value to gardeners, many ornamental varieties of plants having originated in the same way that the silver-variegated Euonymus did. (Fig. 5.)

sides. The color of the variegated leaves is very light green, very different from the color of the ordinary leaves, so much so in fact that it can be easily distinguished by even the most casual observer. The variegated leaves usually have a narrow margin of white or silver color around or nearly around the entire leaf. Irregular areas or stripes of white or silver color usually mark the upper surface of the remainder of the variegated leaf area, while the under surface is usually of a more uniform color.

The stems of the variegated branches are of a silver color in contrast with the uniform green of the ordinary stems.

I have found green branches frequently occurring in variegated shrubs, and variegated branches in green shrubs. A propagator of Riverside informs me that he has repeatedly propagated both varieties from bud variations through the selection of cuttings. In this way, he has isolated the variegated form from the green one, and the green form from the variegated.

This case is presented as an instance of the origin of a valuable cultivated variety of plants through the propagation of bud variations. It is probable that some of the other varieties, if not all, of *E. japonicus* have been developed from bud variations.

It is also a good illustration of the fact that a bud variation rarely affects one character of the plant alone; it frequently produces changes in many different characters simultaneously.

A Valuable Text-Book of Animal Breeding

THE BREEDING OF ANIMALS, by F. B. Mumford, dean of the college of agriculture and director of the experiment station of the University of Missouri. Pp. 310, price $1.75. New York, The Macmillan Co., 66 Fifth Avenue, 1917. (Rural Text-book Series, L. H. Bailey, Editor.)

Most of the questions which a livestock breeder asks are answered in Dean Mumford's book, which can be cordially recommended. Reproduction, inheritance, and development all receive full discussion, illustrated with numerous examples, and with the omission of most of the unnecessary technicalities. Of course, neither this book nor any other will teach a man how to become a successful breeder; that art can be learned only by practice. Professor Mumford's chapter on "The Practice of Breeding" is perhaps not quite up to the standard o' the rest of the book, but it is really difficult to say anything on that subject, which will be of value for immediate application. On the whole, however, his book gives the facts which the breeder, whether a novice or an old hand, wants to know, and it is marked by sound judgment. The errors noticed are few and of minor importance.

Families of American Men of Science

Ten per cent of the well-known American men of science are unmarried, according to J. McKenn Cattell, who has studied the histories of 1,000 of them (*The Scientific Monthly*, March, 1917). Considering their ages, a scientific man is more likely to be married than a man taken at random from the community. At the average age of 29.5 years, they married wives aged on the average, 26 6 years. The American men of science have on the average seven-tenths of an adult son, each. Family limitation is much practised.

The Number of Chromosomes in Man

The exact number of chromosomes in the germ-cells of man has long been in doubt. H. L. Wieman of the University of Cincinnati reports, in the *American Journal of Anatomy* (January, 1917), a study which convinces him that the reduced number is twelve, one of which is the sex-chromosome. The number is the same in both negro and white races, he finds—previous work had led to the belief that the negro had twice as many as the white.

THE SWEATING APPARATUS

Tropical Races Are Provided with More Sweat Glands Than Are the White Races of Northern Climates—Valuable Adaption Brought About by Evolution

IN THE course of evolution the races of the tropics must have become different from the northern races in many ways. Skin color is the most conspicuous one. Differences in disease resistance are of great importance. It has further been suggested that the tropical peoples have a more effective mechanism for regulating the internal heat of the body than have the residents of cooler climes.

The body temperature is partly kept down through the evaporation of sweat from its surface, and it has been said that the sweat glands of the tropical races are larger and more numerous than those of northerners. It has also been alleged that they work in a different way: "According to Aron, the Negrito secretes small beads of sweat over the entire body, which soon forms a thin film. As the whole surface of the body is covered by this water film, the maximum cooling effect from evaporation is attained. In the case of the white man, on the other hand, the sweating is practically limited to certain areas of the body surface. In these areas the sweating may be quite profuse, but as most of it drops off, comparatively little cooling effect from evaporation is produced."

When American men of science became established in the Philippines, one of the investigations they undertook was to get more definite evidence about the differences in adaptation of various races to life in the tropics. This is not merely a matter of academic interest; if certain adaptations are necessary to enable a race to live in the tropics, and if the white race lacks these adaptations, it is evident that tropical colonization by the white race will never be permanent. But if there are no unchangeable differences of this sort; if it is merely a question of proper clothing and diet and knowing how to care for the health, the white races might be able to spread over a great deal of fertile territory outside of the temperate zone.

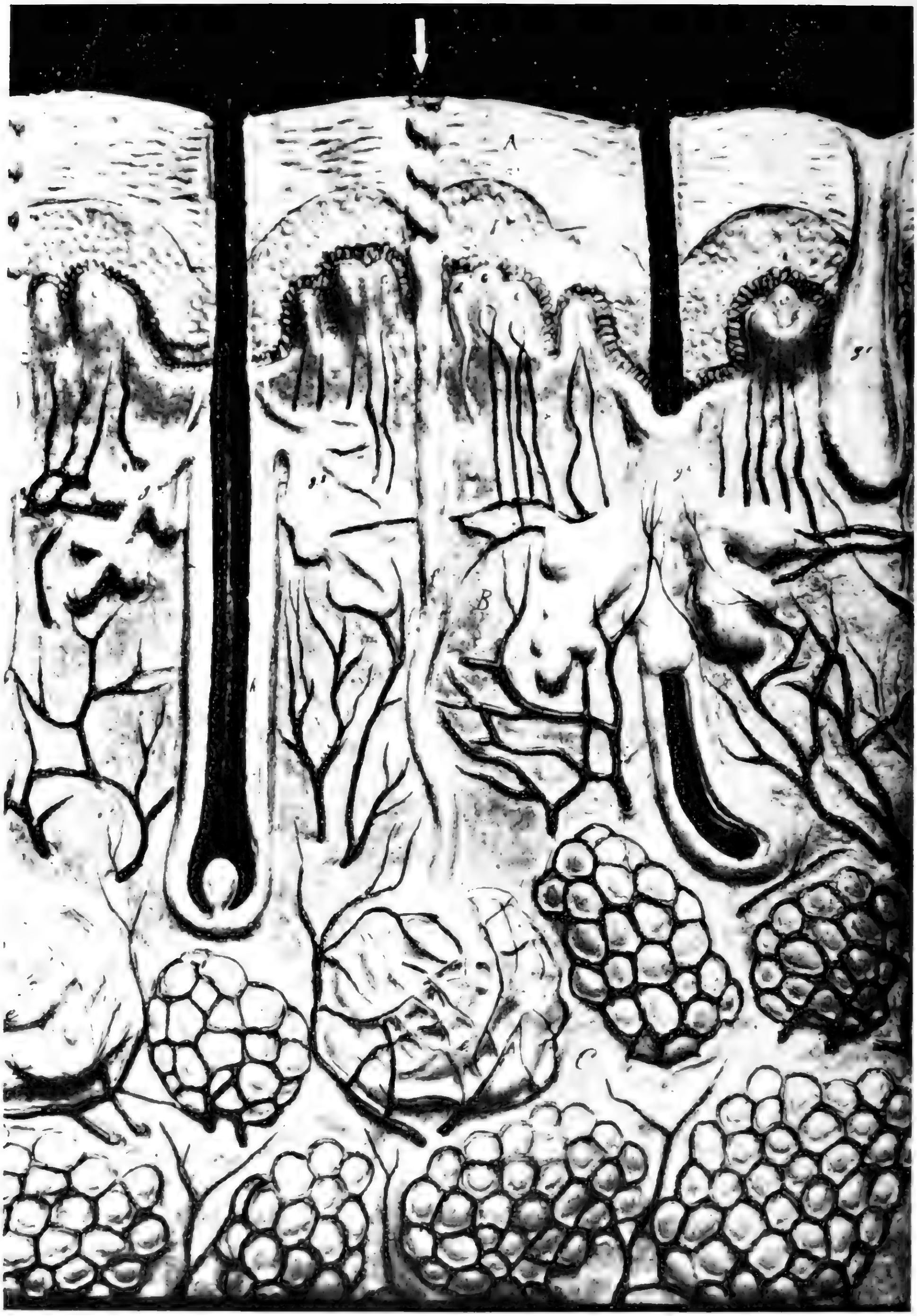
The late Lieut. Col. Chas. E. Woodruff brought together a great deal of evidence to show that the light skin of the white race is an almost fatal handicap in warm climates. The Philippine students proposed to investigate as many similar characters as possible, and Clark and Lhamon undertook the study of sweat glands. They have recently published a preliminary report[1] which shows that the alleged differences do exist, and that they are of considerable extent.

A count of more than a quarter of a million sweat glands in individuals of different races has shown them that there is much variation in size in an individual. Those on the palm of the hand and the sole of the foot are the most constant in size, and also appear first in the embryo. It seems probable that the glands on those two surfaces are more useful to moisten the skin and prevent slipping than they are to reduce body temperature.

The following table shows the average number of glands per square centimeter of skin area on the fingers of men of various races:

American (white)	558
American (negro)	597
Filipino	653
Moro	684
Negrito (adult)	709
Hindu (Sikh?)	738
Negrito (youth)	950

[1] Observations on the sweat glands of tropical and northern races. By Elbert Clark and Rushkin H. Lhamon, Department of Anatomy, University of Chicago, *Anat. Rec.*, xii, pp. 139–149, February, 1917.



AN IMPORTANT PART OF THE BODY'S REFRIGERATING APPARATUS

Among other functions, the sweat glands allow water to evaporate from the surface of the body, thereby reducing its temperature in warm weather. The above model shows two conspicuous black hairs and between them (its mouth marked by an arrow at the top of the picture) a sweat gland. From its opening on the surface, a fine tube which may be as much as a third of an inch long runs down and ends in a coil, surrounded by capillary blood vessels. Water from the blood filters through the walls of these vessels into the sweat gland and is discharged on the surface of the body. The tropical races, who have most need to keep the body cool, are provided with many more sweat glands than are the northern peoples—an example of their constitutional adaptation, through evolution, to the climate in which they live. Photograph from René Bache. (Fig. 7.)

"Taking the American white soldier as the standard, the number of sweat glands per unit of skin area was found to be 6.83% greater in the American negro soldier, 16.61% greater in the Filipino soldier, 23.34% greater in the Moro soldier, 26.81% greater in the adult Negritos, 31.72% greater in the Hindu, and 69.82% greater in the Negrito youths and children. The greater number of sweat glands per unit area with the Negrito youth and child is no doubt due to a corresponding difference in size of individuals. As all the sweat glands are fully formed at birth it is merely a question of the increase in skin area during growth bringing about a dispersion of the glands."

Thus the supposition that evolution has, by natural selection, provided tropical races with more sweat glands than the northern races, is borne out by the actual counts. The writers conclude:

"We are not able to confirm Aron's observation that the tropical aborigines secrete only small beads of sweat over the entire body. On two tramping expeditions in the mountains of the Philippines which we were fortunate enough to arrange with a number of Negritos we observed streams of sweat running down the back, and copious sweating on scalp, forehead and face and sweat dripping from the chin."

Research in Plant Genetics

Among the genetics problems under investigation by A. F. Blakeslee at the Carnegie Institution Laboratory, Cold Spring Harbor, L. I. (says the annual report of the institution) are: inheritance of self-sterility in Rudbeckia, Helianthus, and Verbena, parthenocarpy in cucumbers, chemical and physical differences between the sexes in dioecious plants, the annual habit in beets, various characters in Geodetia, Clarkia, Portulaca, Fraxinus, Betula, Morus, Populus, and Salix," and particularly the inheritance of mutations in *Rudbeckia hirta* (15,000 pedigreed plants were grown last year) and Datura.

A New Handbook of Mendelism

A MANUAL OF MENDELISM, by James Wilson, Professor of Agriculture in the Royal College of Science for Ireland, Dublin. Pp. 152. London: A. & C. Black, Ltd., 1916.

Professor Wilson first gives a historical review of Mendelism and a description of its fundamental principles, and then in a comprehensive and well-planned way outlines the additions and extensions which he thinks justified. The book is well written, but some of the most important points are unfortunately supported by evidence, particularly from animal breeding, which seems to the reviewer to be of more than doubtful validity.

A Posthumous Book by Darbishire

AN INTRODUCTION TO A BIOLOGY, and other papers, by A. D. Darbishire. Pp. 291, price $2.50 net. Funk & Wagnalls Co. 360 Fourth Avenue, New York, 1917.

Mr. Darbishire died recently while training for military service in England, and most of his published papers on genetics have been collected in this posthumous volume. The first eighty-eight pages are taken up by the essay which gives the book its title, and which represents the unfinished attempt of the author to interpret the vitalistic biology of Samuel Butler and Henri Bergson. It is agreeably written and stimulating of thought, but unfortunately the part which the author had completed was only introductory, and therefore is suggestive rather than convincing. The other papers deal principally with the supposed conflict between Mendelism and biometry, and are already known to geneticists. While they possess real value, the longest of them are considerably out of date. On the whole, the book is not so much a contribution to science as a self-revelation of the frank, idealistic, enthusiastic author, for whom the reader can hardly help carrying away the feeling of warm friendship which it is said was experienced by all who met him during his lifetime.

COLOR INHERITANCE IN MAMMALS

Results of Experimental Breeding Can Be Linked up With Chemical Researches on Pigments—Coat Colors of All Mammals Classified as Due to Variations in Action of Two Enzymes

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HEREDITY as looked upon since the time of Weismann is relatively simple to understand. It consists merely in the persistence of a certain cell constitution (in the germ cells) through an unending succession of cell divisions. We see something of the mechanism, back of this persistence, in mitosis. We understand complications brought about by the reduction division and by the union of two germ cells at fertilization. Thus we no longer puzzle over the problem as to how an individual packs his characters into his reproductive cells, the problem which led to Darwin's theory of pangenesis. But if heredity seems simpler than it did half a century ago, the problem of development has become more complex. We see clearly that development is no mere unfolding and growth of elements already present in the fertilized egg or even a sorting out of germinal rudiments for parts of the organism. The germ cell has a certain highly complex constitution, the adult organism another such constitution, and between the two is no simple one-to-one relationship. An almost infinitely complex series of interactions of elements must take place at each stage of development. The difficulty in the study of heredity is that the characters of the germ cell must be deduced from a study of variation in characters at the other end of the developmental history. The wonder is that with such a method it has been possible at all to demonstrate unit variations in the germ cell. One of the most remarkable results of recent genetic work has been the detailed correlation of these hypothetical characters of the germ cell with structures actually observed there.

It remains for genetics to assist embryology and biochemistry in filling in the links in the chain between germ cell and adult in specific cases. Variations of adult characters must be traced back through the contributing causes at each stage of development until, if possible, something is learned of the nature of the ultimate germinal factors involved and, on the other hand, the ramifying influences of unit variations in the germ cell must be traced forward through development. Probably the most favorable point of attack for such work is in color inheritance in animals and plants. A larger number of unit factors have been isolated than in other kinds of characters and are available for comparative study. Much progress has been made in the chemistry and mode of formation of many of the pigments, notably the melanins, with which we are chiefly concerned in the higher animals. The very fact that it has been relatively easy to isolate unit factors in work on color inheritance suggests that in this case the chain of processes between germ cell and adult may be relatively simple. Observations which indicate that melanin pigment is formed in the cytoplasm of cells by the secretion of oxidizing enzymes from the nucleus suggest that the chain may be very short indeed when it is remembered that genetic factors are probably characters of the chromosomes and that these seem to be distributed unchanged from the germ cell to all other cells.

The present paper is an attempt to make as simple a classification of color factors in mammals, based on their effects, as possible, and to suggest a working hypothesis which will relate the biochemical knowledge concerning melanism with this classification and

with certain peculiar relations between the colors. The writer wishes to emphasize, however, that for the present the chemical terms are used rather for the sake of giving a definite scheme to which genetic facts may be referred than for their own sake. Since the earliest work on color inheritance, many geneticists, notably Cuénot,[1] Castle,[2] and Little,[3] have tried to give a physiological interpretation to their results. The hypothesis advanced here is based to some extent on their conclusions with modifications intended to bring under one point of view certain curious new facts.

COLOR IN MAMMALS

Melanin pigment is found in the skin, fur and eyes of mammals. The present paper will deal largely with the gross effects as our knowledge of the ultimate differences of the colors is still very unsatisfactory. Only mammals are dealt with, as in other classes on which genetic work has been done the pigment colors are largely masked by structural effects.

The most highly pigmented condition is found in the color black. The pigment granules in this case are not really black but a very dark sepia brown. White in mammals seems always to be a structural color found in the absence of all pigment. There are two distinct series by which black may be reduced toward white. There is first the type of dilution found in brown and tow-colored human hair, or in dilute black guinea-pigs, which reveals the sepia color of the pigment. A very different kind of dilution of black is to be seen in the so-called blue or maltese mammals—blue mice and rabbits, maltese cats, etc. The effect is somewhat similar to that in blue roans among horses and cattle and seems to be due to a similar cause on a finer scale. Blue roans have an intermingling of jet black hairs and white hairs while the maltese mammals have dense black pigment masses alternating with colorless spaces within the hair.

The colors which do not enter into either of these dilution series or their combinations are those which have a distinct orange-yellow tinge such as is seen conspicuously in red human hair, red and yellow cattle, bay, chestnut and dun horses, tan dogs, etc. The most highly pigmented colors of this kind are the so-called reds. The pigment granules appear orange-yellow in such hair, but it does not seem to be settled whether there is an essential chemical difference from sepia-brown granules or merely some structural difference. The appearance of the intense reds varies somewhat in different mammals, but there seems little reason for doubting their essential similarity. Red undergoes different modes of dilution comparable to those described for black. Reduction to yellow or cream is comparable to the sepia type of dilution of black, while a more coarsely granular type of dilution comparable to maltese is found in light reds. These light reds are slightly redder in hue than the yellows of similar intensity. The two series may, of course, be combined.

Finally there are intergrades of various sorts between the different sepia and yellow series. A coarse-grained mixture gives the effect of bay, dun, or sooty yellow depending on the intensity of the colors. A finer type of intergrade seems to be present in the chocolate color of brown mice, rabbits, guinea-pigs and liver-colored dogs. These browns, however, are much closer to the sepias than to the reds and yellows and are not always distinguishable. Genetic evidence sharply distinguishes browns which are due to reduction of black toward white, and browns which are reductions toward yellow.

By combining the different kinds of dilution with the different kinds of intergrades between sepia and yellow an almost infinite variety of colors is produced, while the complex patterns in which these colors may be distributed make possible still further diversity in color effect.

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[1] Cuénot, L. 1903. *Arch. Zool. Exp. et Gén.* (4), Vol. i. Notes et Revue, p. 33.

[2] Castle, W. E., H. E. Walter, R. C. Mullenix and S. Cobb, 1909. Carn. Inst. Wash. Pub., 114.

[3] Little, C. C., 1913. Carn. Inst. Wash. Pub., 179.

Skin color in general corresponds roughly with hair color. The pigments in the eyes are like those in the skin and fur, but the appearance is generally much modified by structural effects. In dilute human eyes, for example, the appearance is blue, although the pigment is sepia brown. In the rodents the reflection from the back of the retina gives a red color when the pigment is reduced, which in the complete absence of pigment becomes pink as in albinos.

CHEMISTRY OF MELANIN

A large amount of work in the last twenty years has firmly established the hypothesis that melanin is an oxidation product of tyrosin or related products of protein metabolism. Enzymes have been extracted in a great many animals and plants, which have the power of oxidizing tyrosin and related substances to dark brown pigments closely resembling the natural melanins. Studies of Hocker,[4] on cultures in vitro of frog mesenchyme indicate that the pigment granules are formed in the cytoplasm immediately surrounding the nucleus, presumably under the influence of oxidizing enzymes secreted by the latter.

The nature of the differences between colors is still far from clear. Onslow[5] could find no chemical differences between pigments extracted from black and yellow rabbits and considers that they differ merely quantitatively. Most others do find chemical differences as well as physical ones. Black pigment seems always to be granular, while red may be either granular or diffuse. Lloyd-Jones[6] found only granules in both intense and dilute black pigeons, and found red granules in red pigeons, but merely a diffuse yellow in the dilute yellows. The Davenports[7] found granules in brown and black human hair, but merely a diffuse color in auburn hair.

There is a distinct difference in solubility between the dark colors and yellow. Miss Durham[8] found that yellow granules in yellow mice dissolve quickly in potash, brown less quickly, and black not at all. Gortner[9] was able to separate two pigments in black wool—one easily soluble in very dilute alkali and also soluble in dilute acids, while the other dissolved only slowly in alkali and not at all in dilute acids. This, of course, is a chemical difference. The acid-soluble type was of protein nature. He considered it to be a diffuse coloration of the keratin structure, while he identified the insoluble type with the granules. In red human hair he found only the acid-soluble type. In brown horse hair and black wool he found both, while in brown and black human hair, black rabbit hair and black feathers of domestic poultry and crows he found only the insoluble type. His two types evidently correspond more or less closely with yellow and black pigment. This difference in solubility does not necessarily indicate that yellow and black are produced from different chromogens. Indeed, Gortner has shown that the insoluble type may be produced from the soluble by treatment with strong alkali. In a brief paper in 1912, however, Gortner[10] reports on a more fundamental difference between the insoluble melanin from black feathers, black rabbit hair and brown horse hair, and the soluble melanin from black wool and brown horse hair. The former yielded some 3% ash consisting largely of iron oxide, while the latter yielded little or no ash. This seems to demonstrate a difference in chromogens in at least these cases. But even here black pigment may consist of a mixture of melanins containing iron and melanins which do not, derived perhaps from the same chromogens as those which under other conditions produce yellow.

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[4] Hooker, D., 1915. *Anat. Rec.*, 9: 393.
[5] Onslow, H., 1915. *Proc. Roy. Soc.*, B-89: 36.
[6] Lloyd-Jones, O., 1915. *Jour. Exper. Zool.*, 18: 453.
[7] Davenport, C. B. and G. C., 1909. *Amer. Nat.*, 43: 193.
[8] Durham, F. M., 1904. *Proc. Roy. Soc. London*, 74: 310.
[9] Gortner, R. A., 1911. *Biochem. Bull.*, 1: 207.
[10] Gortner, R. A., 1912. *Proc. Soc. Exp. Biol. and Med.*, 9:3.

The chemical difference which Gortner found suggests that the presence of iron bearing chromogens may be the thing which is determined by Mendelian factors for black as opposed to yellow. Such a view, however, is not in harmony with certain other results. Miss Durham[11] found an enzyme difference in the skins of black and yellow guinea-pigs. Onslow[12] was unable to confirm Miss Durham's results, but also found an enzyme difference. He was able to extract a peroxidase from the skins of black rabbits but not from yellow rabbits. It seems unlikely that the same factor should determine both the presence of a particular chromogen and of a particular enzyme. One way to reconcile Gortner's and Onslow's results is to suppose that a feebly acting enzyme oxidizes certain chromogens in the cell giving the appearance of yellow. In the presence of a more powerful enzyme these chromogens and also others (including some containing iron) are thoroughly oxidized yielding sepia granules. Such a view fits in excellently with our knowledge of the relations of the colors in heredity.

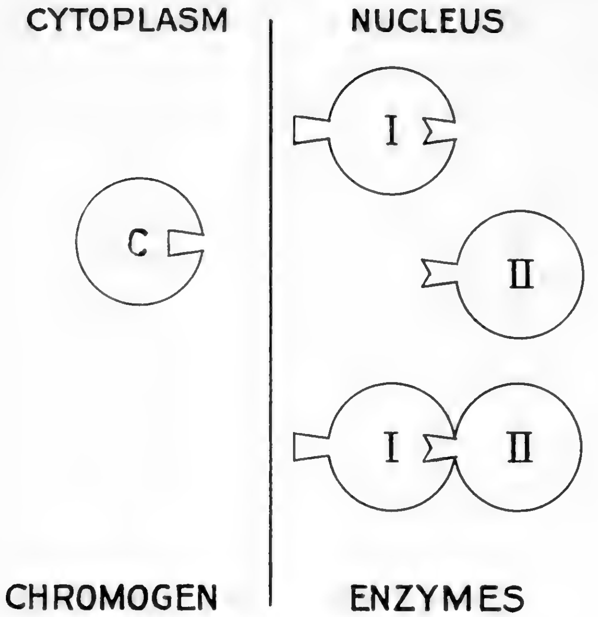
The processes which yield black and yellow are not independent of each other. Both may be reduced or inhibited by the same factor. Onslow investigated several such cases in rabbits. He was able to extract peroxidases from the skins of black, blue and gray rabbits which in the presence of hydrogen peroxide would convert tyrosin into dark pigments. He was unable to extract such enzymes from the white parts of Dutch rabbits and from albinos, both recessive whites. In both cases (as well as in the case of yellow rabbits) the addition of tyrosinase from another source to the solution of extract and tyrosin enabled pigment to develop. As the Dutch pattern and albinism affect yellow and black stocks of rabbits alike, it is evident that our feeble enzyme for yellow and the powerful one for black must contain some common element the loss of which prevents either kind of pigmentation. Thus in different animals of a stock or in different areas on the same animal black and red tend to be intense, dilute or absent alike. But in the same area, there is, in general, a reciprocal relation. Black and red, it is true, may be present together as in reddish-brown human hair and brown horses, but in most cases black obviously increases at the expense of red. This demonstrates either a common chromogen or a common enzyme element or both in the production of black and yellow. More will be said of these relations later.

We have noted several very different kinds of color variations which Onslow has shown to be due to hereditary differences in the enzyme element of the reaction, viz., recessive yellow, albinism, and a recessive white pattern. In two other kinds of variation he obtained a result similar in this respect. In the white parts of English rabbits and in the white belly of gray rabbits—the former due to a dominant factor for white pattern, the latter to a dominant factor for yellow pattern (the agouti factor)—he was not only unable to extract oxidizing enzymes, but found positive inhibitors to be present which prevented pigment production when peroxidases from other sources were added. Gortner[13] has shown that certain chemicals actually have an inhibitory effect on the reaction of tyrosinase with tyrosin and suggested the bearing on the problem of dominant whites. The point of most interest here is that color variations of nearly every kind have been shown to be due genetically to variations in the enzyme element of the reaction which produces pigment.

HYPOTHESIS

The chemical and histological investigations indicate: first, that melanin is produced by the oxidation of certain products of protein metabolism by the action of specific enzymes; second, that this reaction takes place in the cytoplasm of cells probably by enzymes secreted by the nucleus; third, that various chromogens are used, the par-

[11] Durham, F. M., *loc. cit.*
[12] Onslow, H., *loc. cit.*
[13] Gortner, R. A., 1911. *Jour. Biol. Chem.*, 10: 113.



I. Basic enzyme for color production. Acting alone on chromogen, produces yellow.

II. Supplementary to I. Has no effect alone, on chromogen or yellow pigment.

I–II. Oxidizes chromogen to sepia. Effective below threshold level for enzyme I alone. Above this level I and I–II compete. (Fig. 8.)

ticular ones oxidized depending on the character of the enzymes present, and finally that hereditary differences in color are due to hereditary differences in the enzyme element of the reaction. The following provisional hypothesis is built around these considerations:

First, we will suppose that color depends on the rates of production or of potency of two enzymes. Enzyme I is essential to the production of any color, but by itself only produces yellow. Enzyme II is supplementary to enzyme I, producing no effect by itself. The compound enzyme, I–II, produces a darker kind of pigment than enzyme I alone, viz., sepia. Enzyme I–II is also more efficient than enzyme I in another way. It produces sepia pigment even when enzyme I is at too low a potency to produce any yellow by itself. Above the level at which enzyme I produces effects, the two enzymes, I and I–II, compete in the oxidation of chromogen. Chromogen which is oxidized by enzyme I to yellow pigment is incapable of further oxidation to black. In the mixture the presence of the relatively pale yellow color serves mainly to dilute the color of the hair. This production of yellow reduces the amount of dark pigment and the apparent intensity of color, both by reducing the amount of enzyme I which can unite with II to form the enzyme for black production and also by using up chromogen which would otherwise become black. That tyrosinase is exhausted in the production of pigment has been shown by Gortner,[14] who also quotes experiments by Roques (1909) to the same effect.

There are three points in the diagram (Fig. 8) at which physiological processes may affect color-production independently, viz., by influence on chromogen, on enzyme I, and enzyme II. In the first two cases color should be modified regardless of its quality. But as there is as yet no experimental evidence that genetic factors determine variations in the chromogen element it will be convenient at present to consider all such cases as due to influence on enzyme I.

The relations between black, red and white in this scheme are obvious. Inhibition of enzyme II when enzyme I is present gives red. Inhibition of enzyme I gives white regardless of

[14] Gortner, R. A., 1912. *Proc. Soc. Exp. Biol. and Med.*, 9: 1.

whether enzyme II is present or not. The intergrading colors must be looked upon as resulting from reductions of various kinds in the activity of the enzymes. We have recognized two distinct types of intergrades between black and red, the coarsely granular type of bays and sooty yellows, and the finer type of chocolate browns. A mere reduction in quantity of enzyme II may perhaps be thought to result in an intermingling of black and red granules as one or the other of the respective enzymes chances to predominate, while a uniform reduction in potency in some other way not involving a reduction in quantity may give the chocolates and the pale browns of the pink-eyed rodents, in which there seems to be little more tendency for red to win in competition than in intense blacks. Similar relations with respect to enzyme I may account for the differences between the maltese and sepia types of dilution of black and the correlated light red and cream types of dilution of red. Of course, any such definite assignment of physiological effects to factors is at present to be taken mainly as a means of visualizing their action in our ignorance of the real physiology. In order to make wholly clear the relations supposed to hold between the different colors on the hypothesis, the accompanying diagram (Fig. 9) is given. Full quantity is represented by two symbols, reduced quantity by a single symbol, reduced potency by a symbol of small size, and complete inhibition or impotency by absence of symbol. Variations in enzyme I are given horizontally, variations of enzyme II vertically.

The classification of color factors which it is desired to present is based primarily on the difference between factors which act as if on enzyme I, and those which act as if on enzyme II. A secondary classification is based on the mode of action. There is a wide difference between factors which produce no effect in parts of the coat though with maximum effect in other parts, *i.e.*, bring out a pattern, and factors which produce the same effect throughout fur, skin and eyes. In the former case increase in the array of factors causes extension of the pattern; in the latter whatever pattern may be present tends to be stationary on increase in the array of factors. There is instead a further general change in intensity. The coarsely granular types of intergrades should perhaps form a third subclass in each main class, but for the present they are most conveniently put with the pattern factors. They can be considered as determining a fine pattern within the individual hairs.

CLASSIFICATION OF COLOR FACTORS

1. Factors which affect distribution and intensity of color, largely irrespective of the kind of color. (Act as if on enzyme I).

(*a*) Factors which affect the distribution of color in contrast with white.

(*b*) Factors which affect the intensity of color in all colored areas of the skin, fur and eyes.

2. Factors which affect the distribution and intensity of differentiation from yellow to black—effects, of course, visible only in colored areas. (Act as if on enzyme II.)

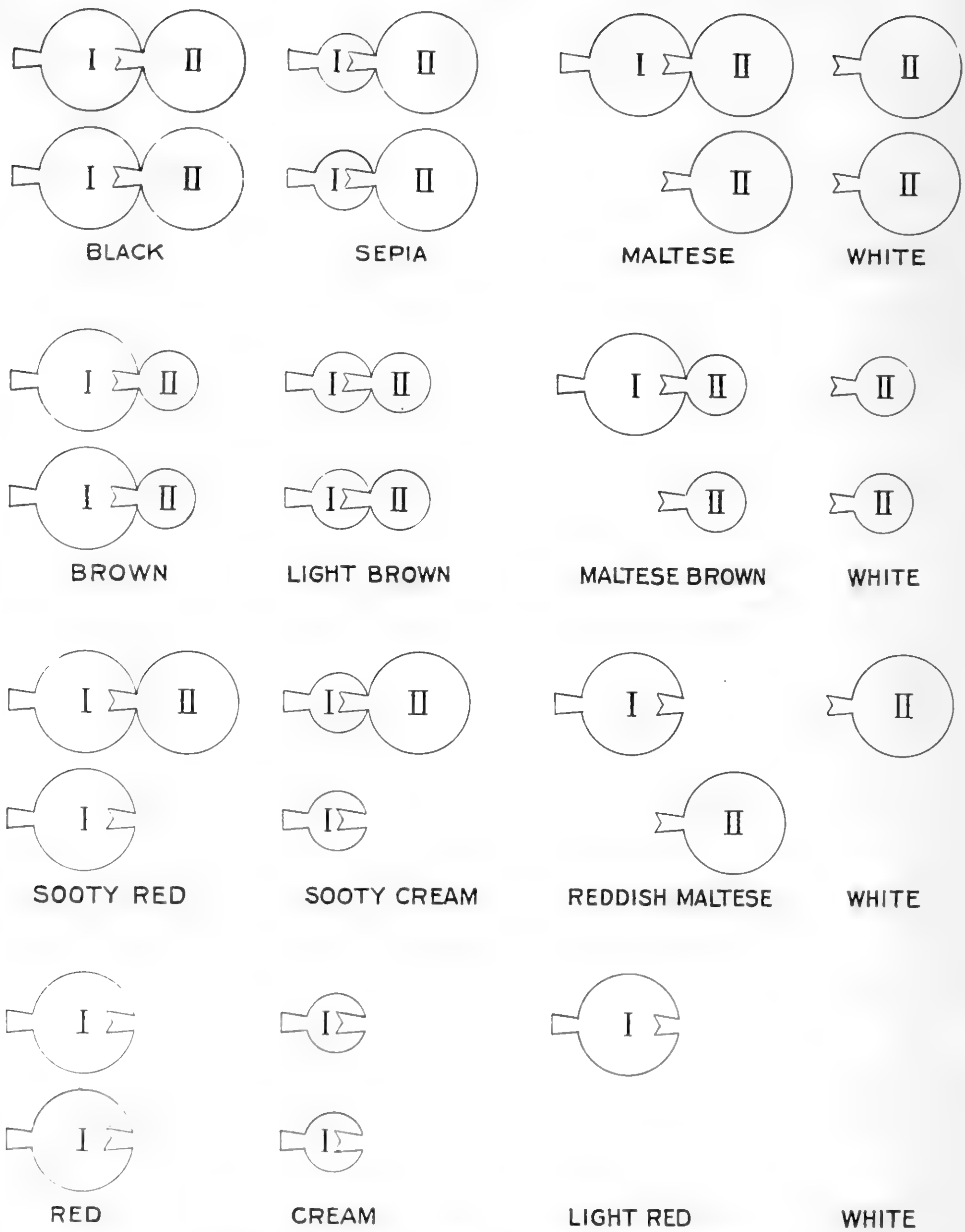
(*a*) Factors which affect the distribution of a dark color (black, sepia, brown, etc.) in contrast with a yellow.

(*b*) Factors which affect the intensity of only the dark colors with effects visible wherever such colors develop in skin, fur and eyes.

This classification differs slightly from one previously advanced by the writer[15] in that classes 2 and 3 of the earlier paper are brought more closely together as classes 2a and 2b.

As an illustration of the classes of factors, consider a guinea-pig which is like a solid black except for the following factors: $\Sigma_w C_d C_d$ AAbb. Σ_w represents unanalyzed hereditary factors of class 1a which determine a pattern of white regardless of anything else. Factor A of class 2a puts a yellow band in each colored hair. Factor C_d of class 1b makes the yellow a dilute yellow instead of red, and makes the dark parts of the hair lighter than otherwise and perhaps

[15] Wright, S., 1916. Carn. Inst. Wash. Pub., 241, part II.



PRODUCTION OF COAT COLORS IN MAMMALS

The inherited color factors can be classified as if acting on one or other of two enzymes. For explanation see text. (Fig. 9.)

slightly dilutes eye color. Finally factor b of class 2b further modifies the sepia in the coat and eye producing light brown but does not affect the yellow. The animal is a brown-eyed light brown agouti with yellowing ticking and a white pattern in the coat.

It is often difficult for one who is not working in the inheritance of coat color to understand just what color is supposed to be determined by a given array of factors. Probably this can be done most easily by considering the factors in the order just given. First are the factors of class 1a which determine patterns of color and white. No factors considered later can change these white areas. Next to be considered is the pattern of dark and yellow colors visible in the colored areas. These are determined by class 2a. Finally the kind of yellow in the yellow areas may be seen by noting the factors of class 1b and the kind of dark color in the remaining areas by a simultaneous consideration of classes 1b and 2b. Eye color is generally determined wholly by these last two classes, but occasionally extreme white patterns of class 1a invade the eye.

DISCUSSION OF CLASSES OF FACTORS[16]

Class 1*a*.—White patterns are very common in mammals and most of them are obviously determined by factors of this class even where the mode of inheritance has not yet been thoroughly analyzed. The factors which determine the white face of the red Hereford cattle are a good example. The same white face appears in the black cattle from the cross of Hereford with Aberdeen-Angus. Evidently the factors involved strike at color in general regardless of its quality. The same is true of the different types of white patterns found in roan and in white Shorthorns, in the black and white Holsteins, and in Dutch belted cattle. The common white patterns of horses, dogs and cats are similarly independent of the ground colors of the animals. This seems to be true of the belt in Hampshire hogs, but is not so certain in other white patterns in hogs which may correspond to extreme dilution of yellow patterns. One or more recessive Mendelian factors have been demonstrated for the patterns of piebald mice, hooded rats, and Dutch rabbits, while a dominant factor is responsible for the English pattern of rabbits and the white blaze in man.

The mechanism by which such patterns are determined is interesting to speculate upon, but very little is yet known. In the case of the English rabbit, Onslow has demonstrated the presence of an inhibitor which prevents the oxidation of tyrosin by tyrosinase. Apparently the power of a cell to produce this inhibitor is determined by a variety of conditions of which the level of the English factor (absent, heterozygous or homozygous) is one and differences brought about in regional differentiation another' As a result of the combined effects of these conditions a given cell either has no power to produce the inhibitor or can produce sufficient to inhibit any intensity of color. The extent of white patterns seems to be the same in general whether the ground color is intense or dilute. In Dutch rabbits Onslow found no enzyme inhibitor but simply an absence of peroxidase. Here we must suppose that some essential condition in the cells for production of enzyme I is determined by the array of recessive white pattern factors in conjunction with regional differentiation.

The maltese type of dilution which appears under the microscope in such a case as the blue rabbit as due to an alternation of colorless spaces with intense pigmentation within each hair is put provisionally in class 1a. Recessive factors which determine simultane-

[16] Most of the statements in regard to color inheritance are based on well-known investigations. A very detailed review of the literature to 1913 is given by Lang, 1914 (*Experimentelle Vererbungslehre*, pp. 467–888). A discussion of our present knowledge on the subject with extensive bibliography is given by Castle, 1916 (Genetics and Eugenics). The writer may say that all of the statements in regard to guinea-pigs can be based on his own experience, and he has also had the opportunity of becoming directly acquainted with the mode of inheritance of most of the color varieties among rats, mice and rabbits as an assistant in Professor Castle's laboratory for three years. Only a few references are cited in this paper.

ously maltese dilution of black and the homologous kind of dilution of yellow have been demonstrated in dogs, cats, mice and rabbits.

Class 1*b*.—Correlated dilution of black and yellow is probably very common in mammals. A case which seems to be dominant is found in the factor by which dun, mouse and cream-colored horses differ from bays, blacks and chestnuts respectively. An imperfectly dominant factor differentiates dun and yellow cattle from blacks and reds.[17] The sepia and yellow guinea-pigs differ from black and red ones by a unit recessive factor.[18] There are two more allelomorphs of this dilution factor. In red-eyed dilutes yellow disappears entirely, giving place to white, and eye color becomes distinctly dilute while in the lowest recessives of the series—the albinos—sepia as well as yellow nearly disappears and the eyes become pink.

Rats show a series of three allelomorphs which seem to be comparable to the guinea-pig albino series.[19] The lowest recessive determines complete albinism while the second member of the series is much like red-eyed dilution in guinea-pigs. Black is diluted, yellow is reduced to white and the eye color to red. Rabbits show a series of three allelomorphs in the complete albino, Himalayan albino and fully colored varieties. Albinism is found in many other mammals and always seems to be recessive in inheritance. There are a number of curious features in the albino series in guinea-pigs which have had much to do with shaping the hypothesis advanced here. The table below shows roughly the model grades of intensity of yellow and black fur and eye color found with each of the ten possible zygotic formulae. Guinea-pigs of these ten formulae can easily be distinguished by the results of crosses with albinos, the lowest recessives. The full evidence has been given in a recent publication.[20]

	Yellow fur	*Black fur*	*Black eye*
CC	Red	Black	Black
CC_d	Red	Black	Black
CC_r	Red	Black	Black
CC_a	Red	Black	Black
C_dC_d	Yellow	Dark sepia	Black
C_dC_r	Cream	Dark sepia	Black
C_dC_a	Cream	Light sepia	Black
C_rC_r	White	Dark sepia	Red
C_rC_a	White	Light sepia	Red
C_aC_a	White	Sooty white	Pink

There are a number of ways in which such a series of four allelomorphs as C, C^d, C_r and C_a can be interpreted. Complete linkage could explain the mere ratios obtained in crosses but leaves wholly unexplained the graded series of physiological effects. Four diverse non-linear variations of a factor would be another possibility. It seems most in harmony with the broad facts of the series, however, to consider these as four levels in potency of some one factor. But with this interpretation two peculiarities of the series stand out at once. First, we get complete albinism in yellow parts of the fur at a level in the series (C_rC_r) at which black in fur and eye is still quite intense. This renders it unlikely that black results from the further oxidation of yellow pigment or the reverse. The hypothesis suggested is that the efficiency of enzyme I, the basic enzyme for color production but which produces only yellow when acting alone, is increased by union with enzyme II so that black pigment is produced at a much lower threshold than yellow. The second curious fact is the bimodal curve of intensity in black fur in passing down the series of zygotic formulae. If C_d C_a determines a higher potency of enzyme I than C_rC_r, it would seem that it should determine a higher intensity of color everywhere. Yet C_dC_a gives a distinctly paler black than C_rC_r but a more intense yellow and eye color. It will be noticed that this irregularity occurs just at the point at which yellow is able to appear and the explanation suggested is that competition of enzyme I with the

[17] Wilson, J., 1909. *Sci. Proc. Roy. Dub. Soc.*, 12: 66.
[18] Castle, W. E., and S. Wright, 1916. Carn. Inst. Wash. Pub., 241.
[19] Whiting, P., 1916. *Sci. N. S.*, 43: 781.
[20] Castle, W. E., and S. Wright, *loc. cit.*

enzyme for production of black, I–II, begins at this point and is able to reduce the intensity of the black produced. Both the available quantity of chromogen and the available quantity of enzyme I are reduced in the production of the relatively pale yellow color. In the eye no factor ever brings out yellow, and perhaps enzyme I is at a much lower level than in the fur.

The different thresholds of black and yellow are attested by a great number of facts. In the dilute rats and Himalayan rabbits as well as in the red-eyed dilute and albino guinea-pigs, black is able to develop but not yellow. In many animals with black and red phases, white patterns appear in the red phase which are absent in the black phase. The white belly of the red fox contrasted with solid sepia of the silver phase is an example. A similar example in rabbits will be discussed later. Again climatic changes in pelage follow the same law. Squirrels and hares lose the yellow in their fur in winter before they lose black. Examples of the competition between black and yellow are discussed under class 2a.

Class 2a.—Factor differences of this group are very common. The factors by which red cattle and swine, bay horses, tabby and yellow cats, bicolor and red dogs; agouti, tortoise and yellow rodents, differ from the blacks in each species are examples.

The agouti factor of rats, mice, guinea-pigs, rabbits, cats, and other animals is an interesting example. In all cases agouti is dominant over the absence of the pattern in blacks, browns, etc. Onslow was able to extract a substance which inhibits the oxidation of tyrosin by tyrosinase, from the white belly of gray rabbits, where the agouti factor removes all black from the hair. Onslow compared the case with the enzyme inhibitor which he found in English rabbits but on our interpretation, the latter was an inhibitor of enzyme I, the former of enzyme II. Since only one genetic factor is involved, it seems likely that the same cause which modifies a solid black rabbit in such a way that yellow ticking appears on the back is responsible for the white belly. According to the hypothesis presented here, white appears on the belly when black is inhibited not because there is a general inhibition of pigment production but because enzyme I is below the threshold for the appearance of yellow. There is a parallel case in the white bellied agouti mice. In this case, however, it is possible to increase the general intensity of pigmentation in the animal so that yellow appears on the belly. In agouti guinea-pigs the belly is normally yellow but paler than the back. Such white patterns as those of the gray rabbit and white-bellied agouti mouse illustrate the possibility of confusing white patterns due really to yellow pattern factors of class 2a acting where enzyme I is below the yellow threshold with white patterns of class 1a. It is likely that many dark-eyed whites among mammals are of the former kind. The polar bear is probably an example.[21]

It has been mentioned that the extent of white patterns seems to be independent of the intensity of color due to enzyme I. A parallel statement cannot be made of the agouti pattern. The latter is greatly modified in extent by conditions which have differential effects on the production of black and yellow. In pink-eyed guinea-pigs with a much reduced potency of enzyme II, the agouti band is greatly widened. On the other hand, the agouti band in ordinary intense guinea-pigs can be greatly reduced by crossing with exceptionally intense blacks. Punnett's density factor in rabbits[22] eliminates the agouti pattern altogether. It is also more effective in the ordinary black agoutis than in brown agoutis. Thus the agouti factor seems to determine a certain quantity of inhibitor which is not as a rule sufficient to eliminate all black and the effect depends not merely on the level of the agouti factor but also on the level of potency or quantity of the substance to be inhibited. The dominant agouti factor (A) and the recessive

[21] Lang, A., 1914. *Experimentelle Vererbungslehre.*
[22] Punnett, R. C., 1912. *Jour. Gen.*, 2.

factor of sooty yellow rabbits (e) make an interesting contrast between two factors of class 2a. In the former case, as we have seen, Onslow demonstrated that an enzyme inhibitor was produced, in the latter he was simply unable to demonstrate peroxidase, indicating a reduced quantity or potency as compared with blacks. The following table shows the effects produced by these factors when added to those of a solid black rabbit (aaEE):

	aaEE	*AAEE*
Back	Black	Black ticked with yellow
Belly	Black	White
	aaee	*AAee*
Back	Sooty yellow	Clear yellow
Belly	Black	White

The case can readily be understood if we suppose; first, that both enzymes I and II are strong on the back but feeble on the belly in all rabbits due to a regional differentiation. We will suppose that enzyme I is below the yellow threshold on the belly. Second, we will suppose that factor A determines the production of an inhibitor with the same subtraction effect on enzyme II everywhere, while factor e determines a general proportional reduction in rate of production of enzyme II. On this basis it follows that factor A produces a partial inhibition of black on the back, revealing yellow but a complete inhibition of black on the belly where, however, only white can be revealed. Factor e reduces black on the back sufficiently to permit yellow to predominate in competition while on the belly, where there is no competition from yellow, what little of the black producing enzyme I-II is produced is fully effective and black, or at least blue, results.

Class 2b.—The factors which reduce the intensity of black areas in skin, fur and eyes without affecting red areas form a clearly defined class. The brown-eyed chocolate mice, guinea-pigs and rabbits; the pink-eyed pale sepia or "lilac" mice, guinea-pigs and rats, and the red-eyed rats of similar coat color[23] differ from blacks by factors of this class. Among the larger animals the difference between liver-colored and black dogs seems to be of this kind. Probably chestnut and liver-colored horses differ from bays and blacks by such a factor. All of these factors are recessive. In the pink-eyed mice, guinea-pigs and rats it is remarkable to what an extent black is diluted without bringing out any distinctly reddish tinge although in red regions of the fur as in the agouti band of gray varieties the red appears in full intensity. There is evidently a different sort of reduction of enzyme II from that in the sooty yellow rabbit. A normal quantity of enzyme II but reduced potency in some other way would seem to be required in class 2b.

SIMULTANEOUS EFFECTS

It has been assumed so far that factors act only on one or the other of the hypothetical enzymes I and II. In the great majority of cases this is satisfactory but it is not impossible that a factor may influence both enzymes in the course of development. In fact the writer will soon publish evidence on one such case in guinea-pigs. Tri-color male guinea-pigs of many different stocks agree in showing a slightly greater average area of color as opposed to white than their sisters, and they also show relatively more black as opposed to red. Maleness seems to determine a higher level of both enzymes I and II as regards pattern. The effect on color is perhaps due rather to a general metabolic difference in the cells of males and females early in ontogeny than to any specific modes of action on the two enzymes. The same may be true of certain coat patterns in which it seems necessary to suppose that the level of enzymes I and II is raised or lowered simultaneously in some respect by regional differentiation. We have cited the cases of the rabbit, mouse, and guinea-pig in which it was found con-

[23] These red-eyed rats first described by Castle (1914, *Amer. Nat.*) under the name of yellows must not be confused with the red-eyed rats described by Whiting (*loc. cit.*). In the former yellow pigment is unaffected and to a large extent gives the color to the fur in agoutis, owing to the great reduction of black. In the latter, yellow is reduced to white, while black is only slightly affected.

venient to suppose that both enzymes I and II are strong on the back and weak on the belly. Similar cases are common. Another sort of example seems to be present in the tiger pattern of cats. In yellow cats the pattern is shown by alternate orange and cream stripes which on our interpretation must indicate alternate stripes of high and low potency of enzyme I. In tabby cats, the intense stripes are solid black, the pale stripes show yellow ticking which seems to require that enzyme II also be strong in the former, weak in the latter.

CONCLUSION

In the present paper an attempt has been made to relate the findings of the biochemist in regard to melanin pigment with the great mass of curious relations between colors which have come to light in genetic work. A scheme is given which is designed to show the inter-relations of the different mammalian coat colors and a classification of color factors is suggested. It is hoped that these will be of use in organizing our present very extensive knowledge of color inheritance and in aiding in the discovery of new facts, or at least in leading to a better scheme and classification.

Finally the bringing under one point of view of biochemical and genetic facts would have great intrinsic interest. The present paper attempts merely to trace the character—coat color—back one stage in development. Instead of considering factors as acting on this one character, they have been divided into two sets acting on two characters, production of the hypothetical enzymes I and II. Suggestions have been made in certain cases in regard to further tracing back of the action of the factors. A more thorough comparison than has yet been made of the effects of factors in all combinations should yield much data bearing on the process of pigmentation and give a very much more complete understanding of the heredity of color than we have at present. By constant comparison of the deductions from such work with the findings of the biochemist, it should be possible in the end to establish a very pretty correlation of results.

Does Racial Intermarriage Lead to Sterility?

That the intermarriage of different races leads to diminished size of family is the conclusion of Prof. Albert Ernest Jenks of the University of Minnesota. His studies in Minneapolis, Minn., Sioux Falls, S. Dak., and in Lincoln County, Minn., convince him that "human hybridization is a powerful factor in America, that it does affect fecundity—being a process toward the gradual numerical weakening of the groups amalgamating. It is thus an increasing factor in America, affecting fecundity to the greatest extent in those families most completely amalgamated." He adds that "as yet the 'American' is not a pure-bred ethnic group but is an extremely amalgamated group, and, in consequence of the amalgamation, is a decidedly impotent group." His investigations are summarized in the Holmes Anniversary Volume.

A Valuable Variety of Barley

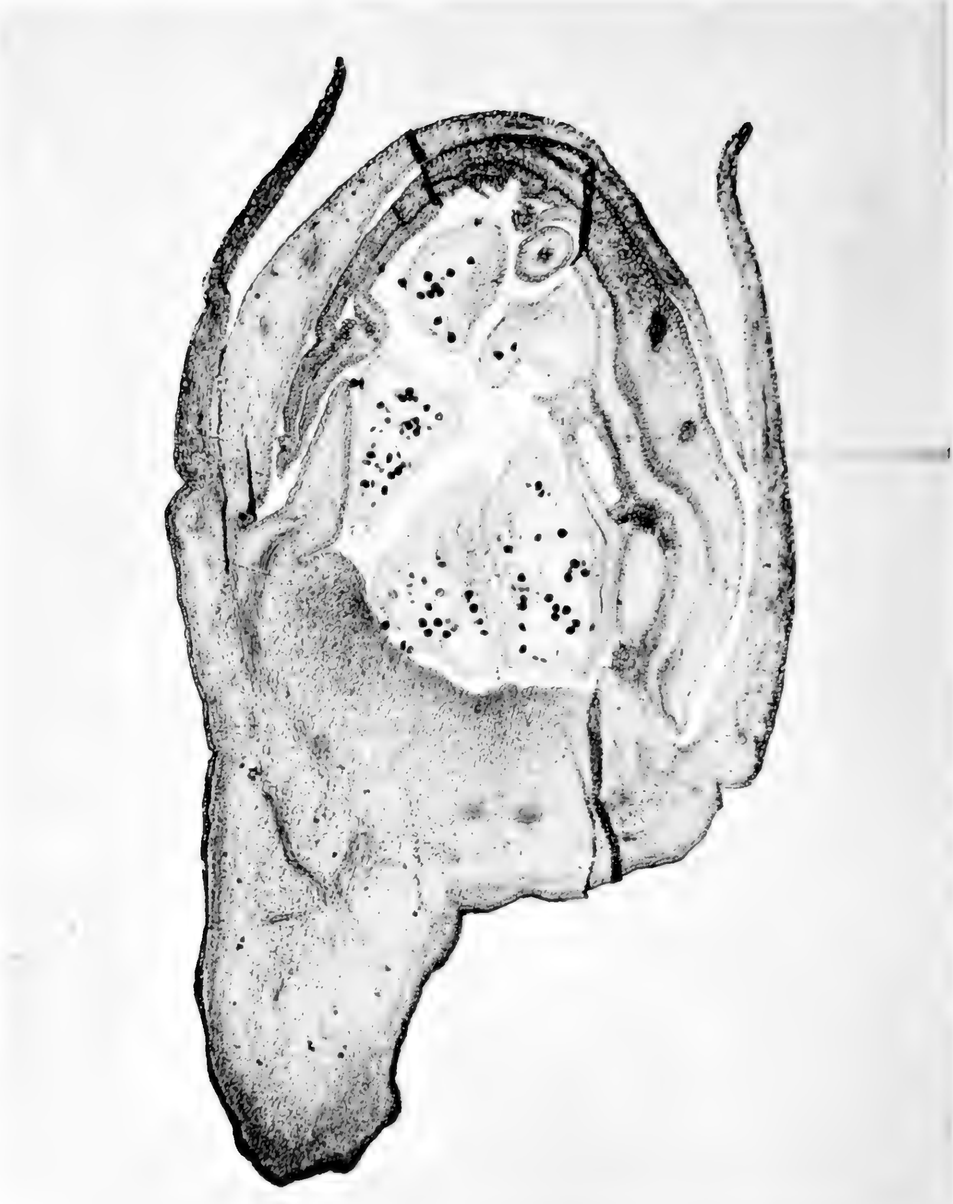
The introduction of the single improved variety of barley called "Plumage" has added at least $1,250,000 a year to the value of the English barley crop, according to the estimate of the British Board of Agriculture. Wheats produced by the Institute of Plant Breeding at Cambridge have also made a notable contribution to the national wealth. Little has been done in England, the board complains, to improve the varieties of roots, rotation grasses and clovers, or any of the minor field crops.

FLOWER BUDS AND LEAF BUDS

Buds which produce only leaves, and those which give rise to flowers and fruit, are quite distinct in most plants, but differ in appearance from species to species. Usually the flower buds are considerably the larger. The pear, shown above, has its flower buds on short spur-branches (at the left) while its leaf buds (at the right), are borne directly on the branch. Photograph, twice natural size, by John Howard Paine. (Fig. 10.)

SECTIONS OF CHERRY BUDS

The surest way to tell whether a bud contains leaves or flowers is to slice it open lengthways with a sharp knife. The cherry buds shown above have been enlarged 15 diameters. At the left is a flower bud. In the cherry, two, three or four flowers are enclosed in a single bud; in this case two flowers can be seen, the conspicuous sacs being the anthers filled with pollen-grains. At the right is a leaf bud which shows nothing except tightly folded leaves. In some cases, such as the apple and Norway maple, a single bud encloses a miniature shoot bearing both leaves and flowers. Photograph by John Howard Paine. (Fig. 11.)



LONGITUDINAL SECTION OF A HAWTHORN FLOWER BUD

When a thin slice of a hawthorn flower bud is placed under the microscope, its structure is revealed clearly. The anthers have been cut through, and the pollen-grains within them stand out sharply as little black dots. The scales which cover the bud on the outside are modified leaf-parts. Photomicrograph by John Howard Paine. (Fig. 12.)

LONGITUDINAL SECTION OF A LEAF BUD

The bud is a very important organ of the plant, and from the young and tender nature of its parts is very susceptible to injury. This is especially true of the "resting buds" of northern climates, which have to survive the winter and are frequently wet and frozen. In tropical climates with plenty of moisture the chlorophyll of the minute leaves might be decomposed by the intense radiation. Buds are carefully protected from these dangers in many different ways, by the older leaves, by scales, hairs, wax, etc. The commonest way is by a modification of leaf-steams to form a relatively hard, smooth, scaly coat. Photomicrograph by John Howard Paine. (Fig. 13.)

A STINGING HAIR

It is a single elongated cell, the walls of which are hardened with silica. Photomicrograph by John Howard Paine. (Fig. 14.)

THE HAIRS OF NETTLES

WHEN you brush against a nettle, you are stung by a very simple weapon. The plant has many fine hairs, each of which is hollow and filled with an albuminoid liquid under pressure. Touch breaks off the point of the hair and leaves, in effect, a tiny hypodermic needle, which injects its contents under the skin, producing a burning sensation that cannot be overlooked.

These stinging hairs, while simple, are of a very specialized character, and at first sight one would feel no doubt that they had some useful part in the plant's life. Otherwise, it might be argued, they would not exist.

ARE THEY USEFUL?

But recent students have strongly questioned this attitude toward nature. In their Text-book of Botany (ii, 577) Coulter, Barnes and Cowles say: "Nowhere in plants is there an organ more clearly fitted for a definite function than are stinging hairs, yet there is no evidence that they are of any special advantage to the plant possessing them. Nothing is known concerning the factors underlying their development, since they neither vary appreciably nor grade obviously into other sorts of hairs."

CANNOT BE DISCARDED

Plants have numerous kinds of hairs, and in some cases it has been found that they are of advantage as a protection from the cold or heat, or to prevent excessive evaporation of moisture. In other cases they do not seem to be of any value to the plant, and may perhaps exist merely as by-products of some part of the plant's evolution. It is likely, the authors above-mentioned think, "that most such hairs are of little or no advantage. The idea should be abandoned that plants have the power to discard organs that are not of use."

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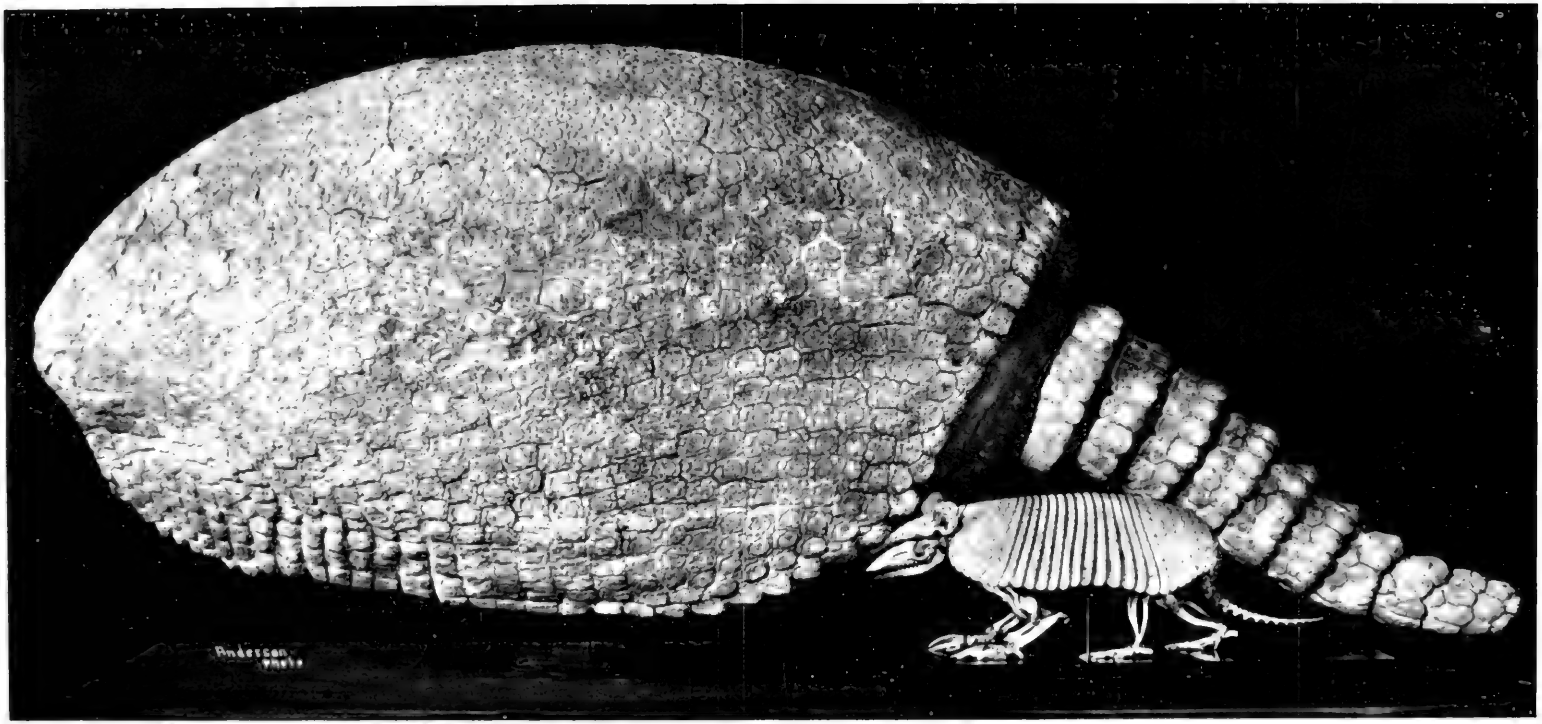


THE ARMADILLO AND ONE OF HIS ANCESTORS

Living armadillos are the representatives of a large family of armored animals of rhinocerine proportions, which flourished in South America in geologic times, thence ranging northward as far as Texas where Henry Fairfield Osborn uncovered the above specimen, a dozen years ago, and named it *Glyptotherium texanum*. It is about 7 feet long, exclusive of the tail. The glyptodonts, as these fossil types are called, may have been immigrants from South Africa, at a time when the disposition of seas and continents was very different from what it is now, but they reached their highest point in size and abundance in the region now occupied by Argentina. Beside the Glyptotherium is the skeleton of a Texas armadillo, its descendant. Photograph from the American Museum of Natural History, New York. (Frontispiece.)

THE BIOLOGY OF TWINS

Light Thrown on Many Interesting Problems by a Study of Twinning—How Twins Are Produced—Critical Experiments in Sex-Determination

TWIN animals represent only the extreme of a process which is found in most living things. In a sense, a man's right hand is the twin of his left hand; or if his body were split in halves from top to bottom, one-half could properly be regarded as the twin of the other. The essence of twinning is therefore "bilateral doubling," which carried nearly to the limit produces Siamese twins, or extended one step farther results in a pair of children who are wholly separated, each one a distinct individual.

The wide range of twinning makes it interesting to every one, and brings in many far-reaching biological problems. H. H. Newman has brought together many of the most important or striking facts in a little book[1] called "The Biology of Twins," in which he considers twins of all kinds in mammals, but particularly the twins of the armadillo, which he thinks furnish "the only key to the mechanics of human twinning."

TWO KINDS OF TWINS

Professor Newman accepts the customary division of twins into two classes. In one case (to which the first paragraph above, refers) two individuals are produced from a single egg. They are, naturally, always of the same sex, and closely resemble each other. They are commonly spoken of as "duplicate" or "identical" twins. In the other case, two individuals are produced from two separate egg-cells, and they are simply ordinary brothers and sisters who happen, so to speak, to develop simultaneously. Whether they will be of the same sex or of opposite sexes is just about an even chance.

The best evidence as to the relative numbers of the two kinds of twins is, in the opinion of Professor Newman, that furnished by the statistics of J. B. Nichols. He found the sex of twins to be distributed as follows, in a large number of cases he collected:

Both males	234,497
Opposite sexes	264,098
Both females	219,312

Roughly, this means for the three classes a ratio of 1:1:1. Since in ordinary births, the sexes are produced in approximately equal numbers, it is evident that, if all twins were nothing more than ordinary brothers and sisters, the ratio ought to be 1:2:1; there would be as many pairs of boys as pairs of girls, and in cases where the twins were of opposite sexes, the number of each sex would be equal.

From this it is concluded that about one-half of the same-sexed twins really stand for only one individual to the pair; they are identical twins. If this reasoning is sound, about one-fourth of all twins born derive from a single fertilized egg cell; the other three-fourths are not "identical" or "duplicate" twins, but ordinary fraternal twins.

HOW TWINS ARE PRODUCED

The development of ordinary twins is sufficiently explained by saying that they result from the simultaneous fertilization and development of two distinct egg-cells. The production of identical twins is more obscure. After an egg-cell is fertilized it splits in two; then each of the halves again divides; and so the division continues almost indefinitely until the whole body is

[1] The Biology of Twins, by Horatio Hackett Newman. Small 12mo, pp. 185. The University of Chicago Science Series. Price, $1.25 net, postage extra. Weight 1 lb. University of Chicago Press, 1917.

formed. It used to be supposed that identical twins resulted when the two halves of the fertilized egg separated after the first division, instead of remaining in contact as they regularly do. But this idea is now considered crude. Newman has to confess that "the problem of the exact origin of duplicate human twins is likely to remain unsolved for a long time to come," but this refers only to the details of the process; there is no doubt that they come from a single egg-cell, in which two centers of growth appear very soon after fertilization.

ARMADILLO TWINS

Some species of armadillo produce duplicate twins regularly at each birth; the species which lives in Texas produces quadruplets by the same process; while a South American species regularly gives birth to eight or even twelve young, all derived from one original egg-cell. The armadillo, therefore, offers excellent material for a study of the process of twinning, and Newman, who has been one of the principal students of it, devotes much space to it in the book under review.

It has been found that for several weeks after the egg of the armadillo has been fertilized, it remains quiescent and undergoes little development. It is this retardation, Newman believes, which results in the establishment of four different growing points, leading to four separate offspring, in place of the ordinary single growing point which would result in a single offspring. But what causes this slowing down? Newman, in 1913, made the rather startling statement that it was due to the presence of a microscopic parasite, probably a protozoan, in the egg-cell. He now feels less confidence in this belief. The parasite may be the cause of retarded development, or merely one of the consequences of it.

THE FREEMARTIN

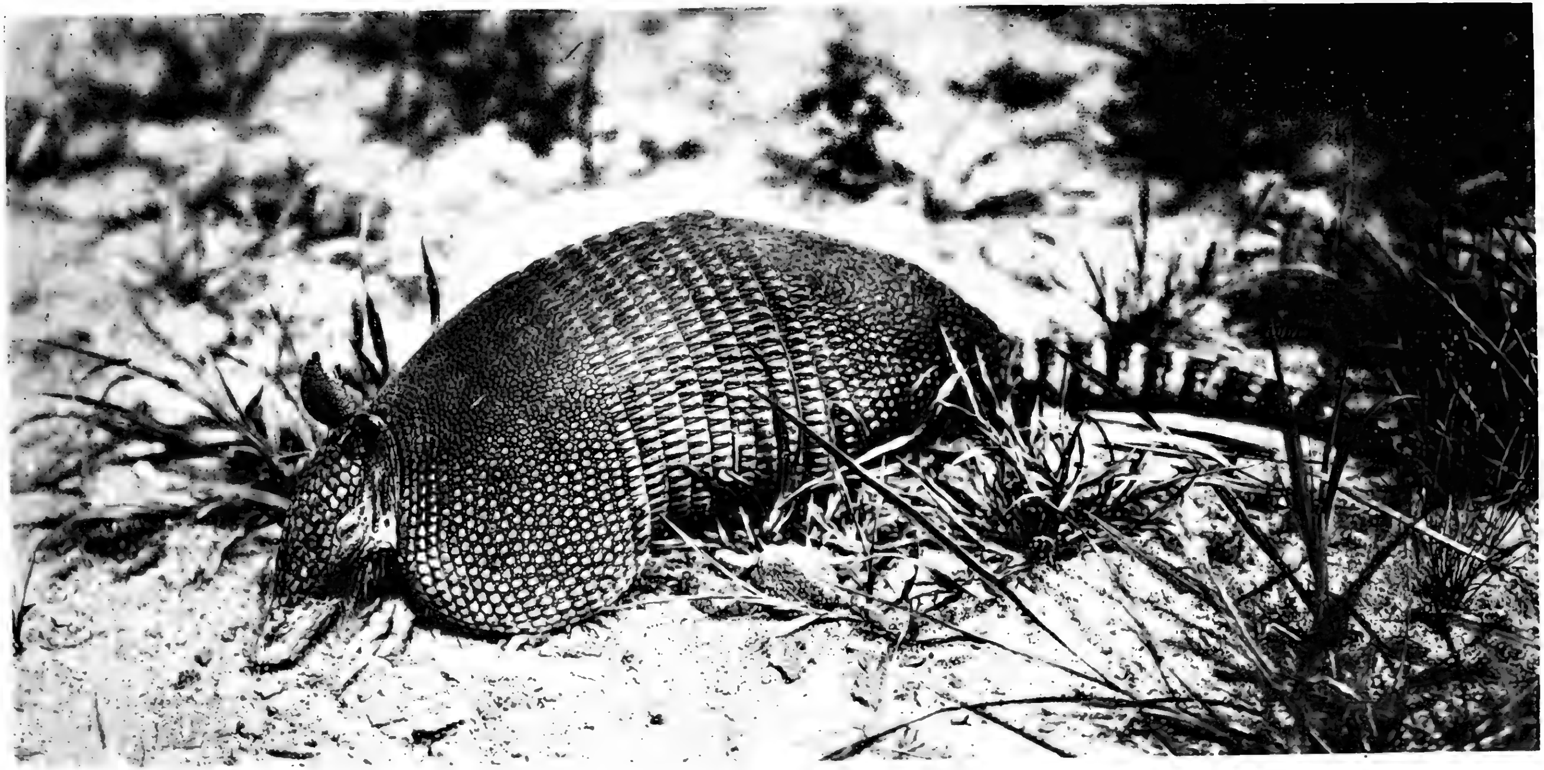
Cattle breeders have long been familiar with a peculiar result of twinning. When a cow gives birth to twin calves of the same sex, they are ordinarily quite normal, but if they are of opposite sexes, the female is sexually imperfect—so much so that until recently it has been supposed that this abnormal twin was really a male. It is called a freemartin, and is always sterile.[2] The mystery of the sterile twin was cleared up recently by F. R. Lillie. Twins in cattle, he found, always result from two separate eggs. At a very early period in development the two embryos lie side by side, partly united, and a constant interchange of blood takes place between them. If both are males or both are females, no harm is done; but if one is a male and the other a female, the reproductive system of the female is largely suppressed, and certain male organs even develop in the female. This is unquestionably to be interpreted as a result of hormone action. The hormones are secretions from the reproductive tissues, which are necessary for the development of the reproductive organs. Probably the hormones of the male become active sooner than those of the female, in the embryonic period. The interchange of fetal blood carries male hormones through the female and prevents the development of the normal female reproductive organs.

Freemartins sometimes occur in sheep, according to W. Bateson, but ordinarily sheep twins are perfectly normal, even if of opposite sexes. Freemartins are not known in other animals.

TWINS AND SEX-DETERMINATION

The problems of sex are today attracting the widest attention, and among these problems that of the mechanism of sex-determination appears to have been largely solved. It appears that in a vast number of animals of all grades of organization, from worms to man, sex is determined at the time of fertilization of the egg-cell. In some forms sex is determined in the egg, for there are two distinct types of eggs, male-producing and female-producing. In other cases the eggs are all alike and produce females if allowed

[2] About one time in eight, a normal female calf is born twin with a male.



THE TEXAS ARMADILLO, WHO IS ALWAYS A QUADRUPLET

The defensive armor of the armadillo is almost perfect, but its purpose is not certain. Its principal use is probably to protect the animal from the thorns that characterize most of the vegetation in which it lives. It also serves to reduce evaporation from the body; but it is not adequate to protect its wearer from mosquitos, who attack at the joints and are the armadillo's greatest enemy. The armadillo lives on ants, grubs, and other insects, and destroys great quantities of cutworms. It would probably pay farmers to extend protection to it. Mexicans and some Americans consider the meat very choice. During recent years the Texas armadillo has been slaughtered in thousands and the shells made into baskets as curios; but the species is said to be increasing rather than decreasing. Photograph by E. R. Sanborn, New York Zoölogical Society. (Fig. 1.)

to develop parthenogenetically (without fertilization), but produce half males and half females if fertilized, the result being due to two kinds of spermatozoa, male-producing and female-producing. In still other cases, notably the hymenoptera (bees, wasps, ants, etc.), males are produced when the eggs are not fertilized and females when the eggs are fertilized. All of these apparently divergent phemonena are consistent with the idea that sex is determined in the germ-cell and that the sex-determining factor is in some way intimately associated with the presence of a peculiar chromosome (the X-chromosome), or group of chromosomes, in the nucleus of the germ-cell. This mechanism gives a sex-bias to the individual, a bias in some cases so strong that no known factors can interfere with the fulfillment of the sex development that was originally determined. In other cases, however, sex may be determined at the time the egg is fertilized, but may require a definite favorable environment to bring it to complete development or differentiation. Finally, in some cases the individual whose sex has been determined as a male, say, in the fertilization of the egg, may have its sex development so altered by outside pressure, as to be almost indistinguishable from a female at maturity.[3]

In mammals there is much evidence that sex is definitely determined at the monent the egg cell is fertilized by the spermatozoön. There appear to be two kinds of spermatozoa and but one kind of egg, and the sex of the individual depends on whether a male-producing or a female-producing spermatozoön fertilizes a particular egg.

If, then, sex in mammals is determined in the undeveloped egg, two or more individuals derived from a single egg would naturally be expected to have the same sex. This is just the point upon which a study of twinning bears, for duplicate twins are, in effect, experiments demonstrating the correctness of the theory of sex-determination which is now held.

If a fertilized egg could be artificially divided into two or more parts, and the individuals developing from these separate parts were always of the same sex, the current theory of sex-determination would be regarded as proved by experiment. The most refined technique is not yet adequate to carry out so crucial an experiment, but nature provides an equivalent one. It has been shown conclusively for two species of armadillo, and by analogy for man, that an egg, divided at an early period, produces individuals all of the same sex. In hundreds of sets of quadruplets of the Texas armadillo there has occurred no exception to this rule, in spite of the fact that in some cases there are marked differences in size of the offspring, due to unequal environment factors. In one case two fetuses of a set are nearly twice the size of the remaining two, yet the sex of all is the same, showing that the sex determined at the moment of fertilization is incapable of alteration through any ordinary change of amount of nutrition and the like.

This generalization holds good in other animals than mammals. Litomastix, a parasitic wasp, lays its eggs in the body of a caterpillar, and a single egg divides very early into a large number of parts—as many as a thousand—each of which produces an adult insect. But these adults are always of the same sex.

If then in two groups as far apart as mammals and insects the fact of sex determination at the time of fertilization is proved by twinning, it seems probable that this is a very general principle, possibly almost universal.

SEX-DIFFERENTIATION IN MAMMALS

Although sex is thus determined in mammals, the differentiation of sex-characters depends on a secondary mechanism that is believed to be associated with an internal secretion of the reproductive organs. It has been long known that castration of young mammals prevents the development of adult sexual characters, and the individual re-

[3] For an account of the way this can be done experimentally in pigeons see "Success in Controlling Sex" (an account of the work of Oscar Riddle, and the late C. O. Whitman), in the JOURNAL OF HEREDITY, vii, pp. 158-164, April, 1916.

IDENTICAL TWINS FROM JAPAN

Yeiichi and Yuji Ogata, of Toyko, at the age of 168 days. Yuji, on the right, is only 30 minutes older than his brother. The father of these twins, a member of the American Genetic Association and himself a twin, states that even the parents have difficulty in distinguishing one from the other. There is no record of twins in the mother's ancestry. Such cases as this are commonly believed to lend support to the view that the tendency for identical twinning is transmitted as readily by the male as by the female. (Fig. 2.)
C. H. Danforth, St. Louis, Mo.

mains a neuter, although determined as a male. An analogous operation on females produces analogous results. Steinach, in a brillant series of experiments with rats, has shown that a transplantation of ovaries into a young castrated male markedly alters its sex-differentiation, making it take on many characters of the female; even milk glands become functional and a maternal instinct develops. The converse operation on a female tends to masculinize her; she becomes large like the male and exhibits the pugnacious character of the latter. Since only the glandular portion of the transplanted ovary or testis survives in these experiments there is no alternative but to attribute the reversal of sex-tendency to some secretion of these glands, and, for lack of a better term, the active principle has been called *hormone*. These hormones must be given off into the blood, for they affect all parts of the body.

Crucial as are the experiments in transplantation of glands, they do not equal in subtlety and finish the experiment of nature performed in the case of the freemartin. Here an individual genetically determined to be a female may become more or less completely differentiated into a male by the very neat device of borrowing hormone-charged blood from its male co-twin.

These results make it necessary to distinguish most carefully between sex-

determination and sex-differentiation. Sex may be determined genetically by the chromsomes at the time the egg is fertilized, but may be altered more or less completely by a change in the hormones. The chromosome mechanism appears to give a strong initial impulse toward a certain sex, and the hormone mechanism carries this impulse forward to completion. But if the hormone mechanism is reversed, the initial impulse of the chromosomes may be overcome, and the animal which should have become a female will become the equivalent of a male, or *vice versa*.

IS TWINNING HEREDITARY?

In the Texas armadillo it goes without saying that twinning is hereditary; it is the only mode of reproduction in this species. What is really inherited in this case is not fully understood, but it is believed that its basis lies in some physiological peculiarity of the egg, which causes it to have an abnormally slow early development. As noted above, this retardation in the developmental rhythm produces an early fission in the embryonic mass and starts separate development at four different points.

The case is not so clear in other mammals. The experiments of Alexander Graham Bell suggest that twinning is to some extent hereditary in sheep, but other studies have failed to find good evidence of this. All the work that has so far been done on the inheritance of fecundity in mammals has yielded very small results. In man, twinning appears to be hereditary[4] to some extent, and it seems possible that the tendency to produce identical twins may be transmitted through the father as well as the mother. The tendency to produce ordinary fraternal twins is, of course, a function of the mother solely, since it depends on the production of two ova at once. But the details of the inheritance of twinning are extremely obscure.

HEREDITY IN THE ARMADILLO

If the character of an individual were determined wholly by heredity, the armadillo quadruplets ought to be correlated perfectly. As a fact, they are found to be correlated to the extent of about .92. But this is what is to be expected, since room must always be left for irregularities in development. Even a bone in a man's leg is not perfectly correlated with the corresponding bone in his other leg, the coefficient being .97. It is evident, then, that while the pattern of the armor (the particular character studied in this case) is largely determined by heredity, there is some irregularity due to differences in development; but that in the case of these identical quadruplets, heredity[5] is nine-tenths responsible for the individual.

Unemployment and Feeblemindedness

That feeblemindedness is an important factor in unemployment is the conclusion of Glenn R. Johnson, who applied tests to a representative group of 107 unemployed men who applied for charity in Portland, Ore. He considers that about one-fifth of the destitute men in Portland (and probably in other cities on the Pacific Coast) are high-grade morons, and as a group all the destitute men were considerably inferior mentally to an ordinary group of successful men. He found there was no relation between wildness in youth and intelligence, and that extreme dissipation did not seem to affect the intelligence level of some men. His conclusions are reported in the *Journal of Delinquency*, March, 1917. His findings bear out the conclusions of other investigators, that many of the men who are "down and out" are not there because they have never been given a chance, but because they are inherently incapable of utilizing a chance given to them.

[4] The best concise account is in the JOURNAL OF HEREDITY, vii, pp. 195-202, May, 1916; Is Twinning Hereditary? by C. H. Danforth.

[5] It must be said that Professor Newman's discussion of heredity is not beyond criticism: *e. g.*, the statement (p. 124) that both kinds of twinning in mammals "are characters capable of being inherited as unit characters."

SIGNS OF INTELLIGENCE

Large Head Is Not a Reliable Evidence of Superior Mentality—Conscientiousness More Closely Associated with Intelligence Than Any Other Trait so Far Measured

DANIEL Webster's head was so large that he had to have his hats made to order; and he was a man of great intellectual ability.

On "evidence" of this sort it has been generally supposed that a large head means superior mentality. But this is by no means the only supposed relation between external physical characters and mental qualities. Phrenology tried to build a science on these relations; and after phrenology was transferred by unanimous consent from the realm of science to the realm of superstition, the task of interpreting character by external appearances was taken over by a school, very active during the last few years in the United States, of "character experts." Their work, which has some scientific backing, has been connected rather conspicuously with the movement for vocational guidance and industrial efficiency. They profess to be able, to some extent, to tell by a man's appearance, and especially by an examination of his face and head, what his mental talents are.

There can be no doubt that, in a limited way, character is really revealed by the face. The habitual use of certain sets of muscles leaves lines which register the most frequent emotions of their bearer. But these traits are so subtle and complex that they can hardly be pointed out, much less measured; so far, therefore, they have remained outside the field of exact science.

It is easily possible, however, to decide by exact methods whether there is any connection between a large head and intelligence, because the head can be measured with calipers and the intelligence measured by school standing or estimated by teachers and friends. Similarly a wide range of other characters can be used with precision. In this way large numbers of persons can be studied and the average results found. To cite the case of Daniel Webster as having had a notably large head and great intelligence does not prove that the two are ordinarily found together in men, yet much of the supposed "evidence" cited by those who diagnose character is not worth much more than that.

KARL PEARSON'S STUDY

The problem can never be solved by citing individual instances, no matter how many thousands of them might be collected. But it lends itself admirably to treatment statistically by the correlation method, and Karl Pearson, the master of this method, has done some work on it which seems to deserve being brought to notice, since it was published in technical form[1] and has attracted little attention.

Professor Pearson's subjects were about 1,000 Cambridge University undergraduates (males) and nearly 5,000 English school children, half boys and half girls. The intelligence of each subject was determined by careful methods, based on school standing and teachers' reports, and was correlated with a number of other characters of which either measurements or trustworthy estimates could be made.

Taking first size of head, three measurements were employed: the length, the breadth, and the auricular height, measured from the line of the ear-openings to the top of the skull. In each case there was found to be a slight connection between size and intelligence. But this is so small that

[1] On the relationship of intelligence to size and shape of head, and to other mental and physical characters. By Karl Pearson. *Biometrika*, v, pp. 105–146. London, October, 1906.

there is no possibility of using it to make even rough individual predictions. On the other hand, if a population were divided into those with large and those with small heads, there would probably be a very slight balance of average intelligence in the former group. The length of head is more closely associated with intelligence than is the breadth, and the breadth than the auricular height, but none of these measurements is of any value for individual character determination.

A long series of other tests was then made. "Judging the series as a whole," Professor Pearson says, "it seems impossible to use any of the physical measurements to estimate intelligence from. Hair color is practically as good as head length or breadth, and eye color as good as auricular height, and even all these are more important than the age influence. Health and temper have more relation to the intelligence than any of the physical measurements we have made, while the intelligent child is popular, athletic, and markedly conscientious. Handwriting is doubly as good a test of intelligence as any head measurement."

"Looked at broadly our table seems to justify fully current common-sense methods of estimating intelligence. Give weight to health, temper, physique, popularity, handwriting, and above all conscientiousness, in seeking friend, assistant, or servant, and in doing this you will most probably obtain intelligence also. If you wish to take anthropometric characters into account—and they are not worth much—hair and eye color will be as valuable as head measurements, and you need not produce the calipers in order to observe them!"

After reviewing his studies of school children in detail, Professor Pearson concludes:

THE INTELLIGENT BOY

"To sum up, then: While no characters in school children so far dealt with show very high correlation with intelligence, we may yet say that the intelligent boy is markedly conscientious, is moderately robust, athletic and popular; he tends rather to quick than to sullen temper. He is more self-conconscious and quieter than the dull boy; he has a *slightly* bigger head, and possibly lighter pigmentation than those of more mediocre intelligence. His hair has a larger percentage of curliness.

"The intelligent girl is also markedly conscientious, moderately robust, athletic and popular. She, too, tends to quick rather than sullen temper. She is less self-conscious than the dull girl, and noisier than the girl of mediocre intelligence. It is the slow girl who is quiet and shy. The intelligent girl has a slightly bigger head than the dull girl, and her hair is more likely to be wavy and much less likely to be curly.

"It may possibly be hinted that these results are of little significance, and had they not been so, they could still have been deduced—without elaborate statistics—from the impressions of a careful and observant teacher. It may be so, but much of science is the verification or refutation of opinions and impressions, and the mainly negative conclusions of this paper place at any rate on a sounder quantitative basis the view that even for the mass, and therefore much more for the individual, little can be judged as to intelligence from the more obvious anthropometric measurements and the more easily noted psychical characters of children.

"The onus of proof that other measurements and more subtle psychical observations would lead to more definite results may now, I think, be left to those who *a priori* regard such association as probable. Personally, the result of the present inquiry has convinced me that there is little relationship between the external physical, and the psychical characters in man."

OTHER STUDIES

More recent studies have not required any important modification of Professor Pearson's conclusions. Measurements of the brain itself have failed to reveal any constant relation between size and intelligence.[2] Ameri-

[2] Biometrical Studies of Man. I, Variation and Correlation in Brain Weight. By Raymond Pearl, Ph.D. *Biometrika*, iv, pp. 13–105. London, 1905.

can psychologists who are interested in the question of character analysis have made a few fragmentary studies, and have shown, for instance, that beauty and intelligence tend to go together—as indeed one would expect—but their methods have been much less trustworthy than those of the memoir above quoted, and the results they have secured have not added much to the knowledge of the problem.[3]

It is not meant here to deny that a skilful man can judge character with some degree of success. Very possibly he can, although such accurate tests as have been made have not always been favorable to the claim, according to Hollingworth's account.

Such success as is attained, it would seem, is due to the way in which a man's face frequently reveals his inner nature. His face may be read in an intuitional way; but any claims for the diagnosis of intelligence by means of measurable features of the head have never been substantiated. Much progress in character analysis is to be hoped for from the use of the exact methods of a modern psychologist's laboratory, but it is doubtful whether accurate results can ever be expected from estimates based on external appearances.

Pearson's Coefficients of the Correlation of Ability with Various Mental and Physical Characters

Character	*Mean (both sexes)*	*Boys*	*Girls*
Conscientiousness	.45	.46	.43
Handwriting	.29	.28	.30
Popularity	.26	.22	.30
Athletic power	.22	.20	.24
Temper	.21	.19	.22
Health	.18	.17	.19
Head length	.11	.14	.08
Head breadth	.11	.11	.11
Hair color	.10	.10	.09
Shyness	.10	.03	.18
Selfconsciousness	.07	.10	.03
Eye color	.07	.08	.06
Head height	.06	.07	.05
Age	.06	.05	.08
Quiet habits	.06	.04	.09
Hair set	.06	.04	.09
Cephalic index	...	−.04	.07

Field Workers' Conference on Eugenics

The annual Field Workers' Conference for 1917 will be held at Cold Spring Harbor on Friday, June 22, continuing on Saturday, June 23, at the Brooklyn Institute of Arts and Science. All members of the several training classes in eugenics, as well as other persons who have been engaged in or are especially interested in modern eugenical field studies, are invited to be present.

The plan will be much the same as that of former conferences. There will be no formal program, but each person present will be invited to tell of his or her work during the past year, and to present for discussion some of the problems which have especially presented themselves. Further announcement concerning the conference will be made next month.—*Eugenical News.*

New Tests for Species and Hybrids

External characters have always given naturalists the means of telling one species from another, but the work of E. T. Reichert and others in recent years shows that internal, physical and chemical characters may be used with much precision. Dr. Reichert describes the continuation of his work in the yearbook of the Carnegie Institution. Many different tests have been made of starches, and it is found that those from one species react differently, in many ways, from those of even a closely related species. Genus and variety also yield distinctive results while hybrids may, by the new methods, be referred to their true parentage. Similar studies are being made of proteins.

[3] Prof. H. L. Hollingworth's book, "Vocational Psychology" (New York, 1916), gives a good summary of the work that has been done.

BREEDING SOUTHERN GRAPES

Scuppernong and Other Rotundifolia Varieties Offer Promise of Large Returns to the Breeder—Technique of Cross-Pollination—Characters That Should Be Improved

L. R. DETJEN

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IN MANY of the South Atlantic States, excellent grapes of the species *Vitis rotundifolia* grow wild in profusion. They were brought under cultivation as early as the first half of the eighteenth century, when tradition says that a particularly good vine found on the wooded bank of Albemarle Sound was domesticated and given the name of Scuppernong. This variety is still the most important and most widely disseminated, a fact which shows that very little systematic improvement of the species has been made, although one variety or another is now to be found in almost every garden along the coast of the Carolinas. Within recent years the great potential value of the rotundifolia grapes has been recognized and their improvement attempted.

Improvement of the grape may follow along several distinct lines. As a wine grape (for which the rotundifolia species has been much used) one set of characters must be selected and intensified; as a table grape other characters must be accumulated and improved, or entirely new ones introduced from another species. Since the wine industry in this country has been demoralized by the prohibition movement, the greatest opportunity of improvement among rotundifolia grapes today lies in the production of a superior table grape. The Scuppernong, as is well-known, together with its kindred varieties in the red and in the black colors, although possessing high qualities and flavors, is decidedly deficient in such characters as are intimately associated with a dessert grape. For example none of the varieties of rotundifolia grapes can be called a bunch grape and none of the better varieties even produces berries that adhere to the stem. This means that the skins at the point of contact are usually broken, micro-organisms make themselves at home in the exuding juices, and the grapes soon begin to sour. Even if the utmost precaution is taken not to break the berry skins the natural sprightly flavor in the fresh fruit of most varieties disappears soon after picking, leaving the fruit less palatable. If we add to all of this the extreme thickness of the berry skins, the very large seeds, and a very high acid content of the pulp we begin to realize the need for improvement in this group of grapes.

Permanent improvement in this species might be attained in two distinct ways: first, by inter-crossing desirable varieties within the species; second, by the out-crossing of desirable varieties with selected vines from without the species.

GREAT VARIABILITY

A survey of the material that has been secured in the way of varieties and seedlings indicates that it may not be necessary to go outside of the species for improvement, but that in due time the patient and persistent plant breeder will succeed in producing a grape worthy of taking its place among the best table varieties.

Although the rotundifolia species with its many undesirable qualities is considered by many persons as very stable, this conception is altogether erroneous, because the species has been found not only to include almost all of the characters that can be desired, but to have them in wide range, so that it will yield great results in the skilled hands of the plant breeder. For instance, the variety Scuppernong generally produces its fruits in clusters of from two to six

THE USUAL DEFECT OF ROTUNDIFOLIA GRAPES

While the species has many excellencies, it also has many drawbacks, one of the most conspicuous being that the clusters are very small. Another is that the berry usually falls from its stem when picked; that is, the clusters shatter. The first object of breeders is to remedy these two defects, which in the past have made the species useful only for the manufacture of wine. (Fig. 3.)

berries, small clusters being the rule. By careful selection of parent vines seedlings have been obtained that generally produce bunches of from ten to twelve berries. Exceptional clusters have been found on rotundifolia vines consisting of from twenty-seven to thirty-three and thirty-five berries; these, however, are quite unusual. By judicious crossing and stringent selection the clusters no doubt can be increased in size so as to include a much larger number of berries until a vine is produced that will rank second to none of the native grapes with respect to size of cluster.

Another instance of variability is the bloom or waxy coat on the surface of the fruit. The berries of the Scuppernong and of other rotundifolia varieties are devoid of the heavy bloom generally so conspicuous on table grapes. Some seedlings of this species, however, have produced a coat of bloom that would do real credit to almost any dessert grape. Again, generally speaking the fruit of

A PROMISING VARIETY FOR THE GRAPE BREEDER

The clusters of Luola, above shown, are really respectable in size, and it also has a fairly good flavor. As rotundifolia grapes are admirably adapted to the section in which they grow wild, it is believed that the production of a few superior varieties will ensure a very large industry in the Carolinas and neighboring States. (Fig. 4.)

Vitis rotundifolia drops from the vine as soon as it ripens. There are some vines, however, whose fruit clings more tenaciously to the pedicels than many a grape of the so-called bunching varieties. In this case it again is simply a matter of transmitting this character by careful crossing to the desired seedling vines.

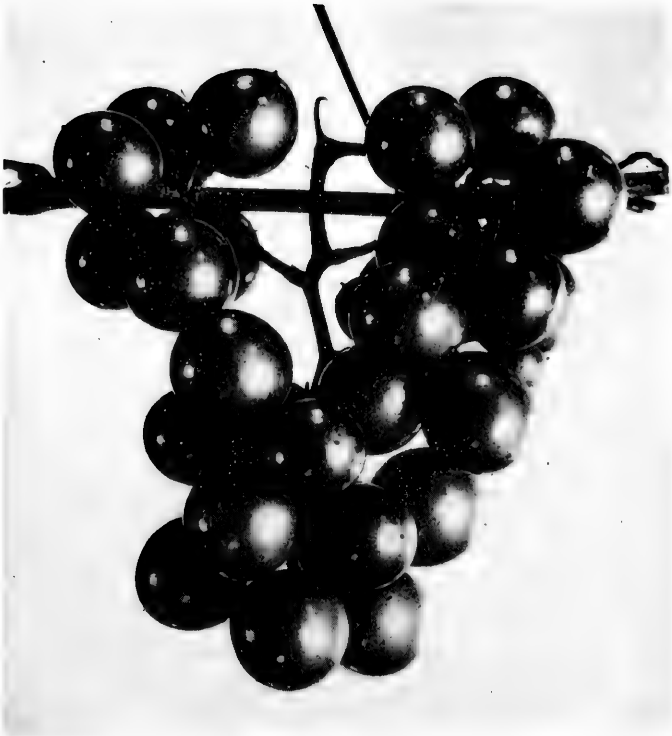
In this same way all of the many other desirable characters from other varieties but of the same species can be assembled, or corralled as it were, the undesirable ones eliminated, and the resultant seedling would still be a rotundifolia grape vine true to type.

The out-crossing method for the improvement of this group of grapes consists essentially of the crossing of selected vines with those of a related species, thereby introducing characters that are foreign to the group. This is often a more rapid method for securing improvement but to the breeder the identity of the species is thereby lost either in part or altogether. The general public, however, cares little about such fine points in methods of achievement and is interested only in the final product, a good table grape.

TECHNIQUE IN CROSSING

The reader, it is presumed, is sufficiently informed as to the methods that are generally used in the crossing of flowers, therefore I shall dwell chiefly on points which may be a departure from the general rule and which might be applicable specifically to *Vitis rotundifolia*.

Grape pollen may be gathered and handled in several different ways. One method that was found to be very convenient is the following. Pollen material is best collected in the morning hours, between 7 and 9 o'clock, because at this time of day very few if any of the



A GOOD CLUSTER OF SANMONTA

Rotundifolia grapes are normally pollinated by insects, the pollen being too heavy and sticky to be carried by the wind. Whether the crop is good depends to a large extent on whether enough insects have been working in the vineyard. In this case a bunch of flowers was bagged, and a bee (family Andrenidae) put in the bag. The efficiency of his work is evident. Photograph natural size. (Fig. 5.)

flower buds have opened and scattered their pollen. Material that is collected on the preceding day is generally not matured enough to go through the regular process of liberating the pollen and difficulty may be experienced in its extraction. Flower clusters with mature buds, and mainly such as will bloom during the same day, are selected and gathered in quantities large enough to insure a sufficient amount of pollen. This material is thoroughly rinsed with clean water to remove or destroy all adhering foreign pollen, hastily dried by removing the excess water either by swinging the material sharply in the air or with the aid of blotting paper, and immediately placed in suitably labeled paper trays. These trays are lightly covered with a piece of clean paper, placed in a dry but airy room, and the buds are allowed to open up naturally, which they will do within a comparatively short time. By noon all of the mature buds will have opened but the contents of the trays are not removed until the following day when the plant material will be sufficiently dry so that the pollen can be extracted.

The process of separating the pollen from the dried flowers is a very simple operation. All that is required is (1) a glass test-tube into which a conveniently small amount of the dried material is placed and shaken. By jarring or gently tapping the tube the fine dry pollen will sift down to the bottom from whence it can be trans-

ferred by means of (2) a small camel's hair brush into (3) a small clean glass vial. After a sufficient amount of pollen is thus secured the vial is lightly stoppered and labeled so that its identity will not be lost when placed among other but similar vials previous to pollination.

Should pollen-bearing flowers for any reason not be plentiful a different method of procedure may be resorted to. The flower buds are gathered, washed, and allowed to open and cure in the paper trays according to the usual methods, but the pollen, instead of being shaken from the dried anthers, is transferred together with them from the paper tray direct to the small receiving vial. Instead of using a camel's hair brush for this transfer a clean forceps is preferred, because the waxy grape pollen is sufficiently adhesive to cause the entanglement of large numbers of the grains with the dried cluster material and with the fine hairs of the brush, thus incurring a great loss of pollen. This waste may be prevented by the use of a clean, fine pointed, steel forceps to which only a comparatively small amount of pollen adheres, and by not shaking the pollen from the anthers but keeping it confined until it is to be applied to the pistils of the female vine.

FRESH POLLEN NEEDED

Rotundifolia grape pollen ought to be used preferably on the same day or the following day after it has been gathered, but in case of necessity can be stored a few days longer. In ordinary room temperature it begins to deteriorate rapidly after it is forty-eight hours old, and not infrequently earlier, hence it is best not to prepare the pollen sooner than twenty-four or thirty hours previous to the time of pollination.

While the pollen is being gathered and cured the flowers of the female parent vine should be prepared for cross-pollination. This can be done by either of two methods, all depending on the nature of such flowers: (1) If these flowers bear the reflexed type of stamen we know that they are self-sterile and also inter-sterile.[1] Being thus affected with sterility they need not have their stamens and pollen removed previous to crossing with other varieties. This knowledge is of the highest importance because by its application much time and labor can be saved to the grape breeder. All that is necessary then to prepare such imperfect hemaphrodite grape flower buds for the event of crossing is simply to inclose them in bags before any of them can open and thereby expose their receptive pistils. (2) If the grape flowers bear upright stamens we know that they are self-fertile and the method of preparing such flowers for cross-pollination is the one that is usually adopted by plant breeders of emasculating the flower buds previous to bagging and pollination. This can be done very conveniently by operating on fully matured buds in the afternoon, thirty-six hours previous to the application of pollen to the prepared pistils. A slight pressure firmly applied above the middle of the bud with a pointed forceps will usually cause the cap and also the inclosed stamens to become detached from the receptacle and leave the pistil bare. When all of the mature buds on the cluster have been thus treated they are thoroughly rinsed or dipped in clean water to wash off and destroy all adhering pollen, if there be any, that might have been discharged by an anther bursting during the emasculating operation. If this precaution is not strictly observed many of the flowers will become self-fertilized and perplexing results might be obtained. The prepared flower clusters are now inclosed within light paper or cloth bags to await the process of artificial hand pollination.

The methods of transferring pollen to the pistils of the bagged flowers are several and choice depends mainly on the amount of available pollen. When this is plentiful the work can be materially hastened by the use of a small camel's hair brush; when it is not so abundant as one might wish, the thumb nail method or the anther and forceps

[1] North Carolina Agricultural Experiment Station Bulletin No. 209.

READY FOR POLLINATION

In the upper part of the photograph are shown three baskets of flower-buds which, after being washed, have opened out and are ready to shed their pollen. Below are three glass vials with camel's hair brushes and some pollen ready to be used in cross-pollination. (Fig. 6.)

may be resorted to. In the former case the brush is used to expedite the actual crossing of the flowers, while in the latter cases economy of pollen determines the method.

When all of the flowers are cross-pollinated the bags are replaced and, if these happen to be made of a thin fabric, are left on the vine until the resulting fruit, if any develops, can be harvested.

STARTING THE SEEDLINGS

Grape seedlings may be started in various ways. The one-seed-to-one-pot method, when used in a greenhouse, becomes too expensive because the pots take up too much space; when used out of doors it is unsatisfactory because uniform conditions of moisture are difficult to maintain.

When greenhouse facilities are available, seeds which have been stratified, should be drilled about one-half inch deep in flats filled with a good, light, greenhouse soil. If no such facilities are available then the seedlings may be started in a similar soil but planted direct in a glass-covered cold-frame. Probably the only advantage obtained by starting the seedlings in a greenhouse is earliness. This method is especially recommended for seeds which have been obtained from flowers that were self-pollinated, because the resulting plants from such seeds are apt to lack vigor.

After the plants have attained a height of 3 or 4 inches they can be set out into nursery rows, in very much the same manner as cabbage plants are and without any serious setback. It is best, however, to shade the newly trans-

planted seedlings during the three following days by covering them with 3-inch flower pots during the daytime. These pots not only provide shade but also prevent rapid transpiration which is so fatal to newly set plants.

Rotundifolia grape seedlings, unlike other grapes, should be trained beginning with the first season by the process of disbudding all lateral growth. When the plants are 1½ feet tall they should be loosely tied to the lower wire of a trellis and as they grow taller they are tied to successive wires higher up. During the second year side branches are allowed to develop and the height of the plant is determined only by the height of the upper wire of the trellis. By the third year the plants, if well grown, should begin to bear fruit.

The study of the seedling vines really commences in the seed-bed and with the majority of them may be concluded in the nursery row. Most of the vine and fruit characters can be secured from the plants while they are growing in the nursery rows. Should the work of the breeder be centered mainly on the clusters and fruits, then the seedlings ought to be given more space for the perfect development of the whole plant.

The Selection of Naval Officers

That naval officers for the present war should be selected partly on their heredity and juvenile promise was the contention of Dr. Charles B. Davenport, of the Carnegie Institution's Department of Experimental Evolution, who addressed the National Academy of Sciences in Washington on April 17. Considering only the "fighting type" of sea captain like Nelson, Cushing, Farragut and Dewey, as distinguished from the exploring, inventive and diplomatic types, he found the following traits usually present in boyhood: (1) love of the sea; (2) nomadism, particularly marked in such a man as John Paul Jones; (3) hyperkinesis, an aggressive, restless temperament; (4) an adventurous disposition and absence of fear; (5) ability to command men. He believed that it would not be difficult to get the necessary data about young men who apply for commissions in the navy, and that selection of them from a eugenic point of view would aid greatly to secure an able body of men.

Delinquency in City and Country

There is a widespread idea that crime and delinquency are particularly problems of densely populated areas. J. Harold Williams has tested this idea by a careful investigation in Southern California (*Journal of Delinquency*, March, 1917). He finds (1) that delinquency is more prevalent in small towns, and rarest in the open rural country; (2) that no particular kinds of offenses committed by delinquent boys are especially associated with city, town, or rural population; (3) that the average level of intelligence is higher in delinquent boys from the cities than in those from the towns and rural districts. The proportion of feeblemindedness is greatest in rural districts.

Dr. Salmon Appointed on Immigration Committee

To fill a vacancy, Dr. Thomas W. Salmon has been appointed a member of the American Genetic Association's committee on immigration, of which Prescott F. Hall, of Boston, is chairman, and Prof. Robert De C. Ward, of Harvard University, is secretary. Dr. Salmon was formerly connected with the U. S. Public Health Service at Ellis Island, and is now medical director of the National Committee for Mental Hygiene.

THE CELIBACY OF TEACHERS

WHETHER women are more efficient teachers than men, and whether single women are more efficient teachers than married women, are disputed questions which it is not proposed here to consider. Accepting the present fact, that most of the school teachers in the United States are unmarried women, it is proper to examine the eugenic consequences of this fact.

The withdrawal of this large body of women from the career of motherhood into a celibate career is desirable if the women are below the average of the rest of the women of the population in eugenic quality. But it would hardly be possible to find enough eugenic inferiors to fill the ranks of teachers, without getting those who are inferior in actual ability, in patent as well as latent traits. And the idea of placing education in the hands of such inferior persons is not to be considered.

It is, therefore, inevitable that the teachers are, on the whole, superior persons, eugenically as well as personally. Their celibacy must be considered highly detrimental to racial welfare.

But, it may be said, there is a considerable number of women so deficient in sex feeling or emotional equipment that they are certain never to marry; they are, nevertheless, persons of intellectual ability. Let them be the school teachers.

This solution is, however, not acceptable. Many women of the character described undoubtedly exist, but they are better placed in some other occupation. It is wholly undesirable that children should be reared under a neuter influence, which is possibly too common already in education.

If women are to teach, then, it must be concluded that on eugenic grounds preference should be given to married teachers, rather than single ones, and that the single ones should be encouraged to marry. This requires (1) that considerable changes be made in the higher education of young women, so that they shall be fitted for motherhood rather than for nothing except school teaching, and (2) that social devices be brought into play to aid them in mating—since it cannot be doubted that a large proportion of celibate school teachers are single from necessity, not from choice, their profession not being favorable to finding mates.

It is, perhaps, unnecessary to mention a third change necessary: that school boards must be brought to see the undesirability of employing only unmarried women, and discharging them, no matter how efficient, if they marry or have children; and that the courts must be enabled to uphold woman's right of marriage and motherhood, instead of, as at present, upholding school boards in their denial of this right.

Against the proposal to employ married school teachers, two objections will at once be urged. It will be said (1) that for most women school teaching is merely a temporary occupation, which they take up to pass the few years until they shall have married. To this it may be replied that the hope of marriage too often proves illusory to the young woman who enters on the pedagogical career, because of the lack of opportunities to meet men, and because the nature of her work is not such as to increase her attractiveness to men, nor her fitness for home-making. Pedagogy is too often a sterilizing institution, which takes young women who desire to marry and deprives them of the possibility of marriage.

Again it will be said (2) that married teachers would lose too much time from their work; that their primary interests would be in their own homes instead of in the school; that they could not teach school without neglecting their own children. These objections fall in the realm of education, not eugenics, and it can only be said here that the reasons must be extraordinarily cogent, which

will justify the enforced celibacy of so large a body of superior young women as is now engaged in school teaching.

The magnitude of the problem is not always realized. In 1914 the commissioner of education reported that there were, in the United States, 169,029 men and 537,123 women engaged in teaching. Not less than half a million women, therefore, are potentially affected by the institution of pedagogical celibacy—an institution which is to be compared with that of sacerdotal celibacy in the amount of permanent harm that it is capable of doing to the race.

The Status of the Presence and Absence Hypothesis

To explain the inheritance of genetic differences, we assume the presence in each germ-cell either of one of two alternative factors (Morgan and his school), or the presence or absence of one unpaired factor (Bateson and his followers). Bateson's "presence and absence hypothesis" applies to Mendelian character differences if they are quantitative, and is extended to the genetic differences in the germ-cells, whether these result quantitatively or qualitatively. It demands, I think, the following subsidiary hypotheses:

1. That even qualitative differences are due to presence and absence, and not to substitution of factors.
2. That dominance (or prevalence) is always the mark of the presence of a factor.
3. That recessive factors do not exist.
4. That even where dominance or prevalence is absent, the side on which the factor is present can safely be guessed at.
5. That all cases of multiple allelomorphs (triangles of Baur) are due to complete linkage.
6. That double presence of a dominant (or prevalent) factor is often more effective than its single presence.

To infer the nature of the germinal factors from the results of their operation is not usually possible in such complicated biochemical machines as plants and animals. Hence the comparative simplicity of the presence and absence hypothesis is, I think, illusory. In working with a quantitative Mendelian difference it is permissible, as a mathematical convention, to regard the result of one factor as zero;[1] but this does not apply to qualitative differences.

1. The two-factor hypothesis escapes the speculation that the dominance or prevalence of a "character" informs us as to the nature of the germinal factor causing it.
2. The two-factor hypothesis applies equally to qualitative differences: *e.g.*, peloric and regular flowers.
3. The two-factor hypothesis is confirmed by every case of multiple allelomorphs discovered.
4. Fluctuation of dominance and absence of dominance are, I think, more readily intelligible on this hypothesis.
5. Few or no subsidiary hypotheses are needed.
6. Dominant mutations, which are a stumbling-block to users of the one-factor hypothesis, agree about as well as recessive mutations with the two-factor hypothesis.

As Morgan and Sturtevant have already shown, the two-factor hypothesis can be used in Mendelian work as well as or better than the presence and absence hypothesis. But in various cases both may be true.

JOHN BELLING.

A New Strain of Hybrid Sheep

A strain of Hampshiredown-Rambouillet hybrid sheep has been almost perfected at the New Hampshire Experiment Station, according to Dr. Charles B. Davenport, who started it. The new breed is said to show in a high degree a union of especially valuable qualities of fine wool and good conformation. A second hybrid generation of a Southdown-Rambouillet cross has been produced.

[1] See "Inheritance of Length of Pod," by John Belling, in *Journal of Agricultural Research*, December, 1915.

BRAINS AND SOCIAL STATUS

Children of Professional and Upper Commercial Classes Found to be the Most Intelligent—Possible Reasons

ARE there considerable differences in natural intelligence between the various social classes of the population? If so, where is the most mental ability found? Do the children of traveling salesmen, for instance, stand above or below those of lawyers? Do the boys of the poorer classes, who roam the streets, really secure that sharpening of the wits which is sometimes credited to them, or are they actually inferior in intelligence to the children of the well-to-do middle classes, who are carefully kept at home?

All these and similar questions are of importance in many ways, and in recent years a beginning has been made at answering them, in a number of psychological researches where mental tests have been used, of a kind that are believed to measure the real mental ability, and not merely the results of formal education.

1. A suggestive contribution is that of F. Umberto Saffiotti and his associates of the Laboratory of Pure and Applied Psychology at Milan, Italy.[1] Mental tests were given to the pupils in four elementary schools, a modified form of the Binet scale being used. Information was also secured as to the social and economic status of the parents of the children, and six groups of fathers were made, as follows:

A. Professional (including higher officials, lawyers, doctors, engineers, accountants, artists, magistrates, officers, professors, etc.).

B. Upper commercial (merchants, managing directors, people of independent means, etc.).

C. Lower commercial (agents, representatives, commercial travelers, inferior and private officials and employes, superior skilled labor such as electricians, mechanics and engravers).

D. Tradespeople (vendors, innkeepers, butchers, grocers, milkmen, druggists, etc.).

E. Artisans (including mechanics and manual laborers, smiths, carpenters, bricklayers, shoemakers, hairdressers, etc.).

F. Servants (domestic employes, shop assistants, porters, commissionaires, etc.).

The children were then classified in three groups, according as the mental tests and, apparently, the school standing showed them to be dull, mediocre, or bright. They were further classified according to their parents' occupations. The results from the first grade only will be cited here; they are as follows:

MENTALITY OF CHILDREN FROM VARIOUS SOCIAL CLASSES

Social group	*No. tested*	*Dull*	*Mediocre*	*Bright*
A. Professional	37	16.2%	32.4%	51 3%
B. Upper commercial	35	22.8	22.8	54.2
C. Lower commercial	71	26.8	29.6	43.7
D. Tradespeople	35	40.0	40.0	20 0
E. Artisans	144	38.9	26.4	34 7
F. Servants	56	30.3	33.9	35.7

The figures are small, but Saffiotti believes the children represent fair samples of their social groups. In mentality, the three upper classes form a somewhat sharply defined group, set off from the lower ones by a well-

[1] Saffiotti, F. Umberto. Contributo allo Studio dei Rapporti tra l'Intelligenza e i Fattori Biologico-sociali. Rivista di Antropologia, xviii, fasc. 1, 2, Roma, 1913. The account herewith presented is taken from one by Cyril Burt in the *Eugenics Review*, pp. 365–373, London, January, 1917.

THE STREET AS A KINDERGARTEN

Popular opinion believes that the children of the poorer classes in large cities acquire a certain amount of valuable education by runn ng on the streets. Actual tests usually indicate, however, that such children stand very low in all the higher forms of intelligence; and this might have been suspected from an examination of the environment in which they are brought up. Association with older people is one of the most important factors in a child's education; but in the poorer classes the dwellings are so small that a child must spend most of his waking hours outside, and nowhere does he come in close contact with many older persons of ability. Photograph by Milton Fairchild. (Fig. 7.)

marked line. The professional group yields the fewest dullards and the trading class the most. The upper commercial group yields the largest proportion of bright children, but the professional group is not far behind. The trading class shows the highest level of mediocrity, and a little distance behind it, the servant and professional class stand on almost even terms.

Single indices of ability were worked out for the six classes, which show that the professional is easily the highest and the trading class the lowest, as represented in these Milan school children:

Professional	51.9
Upper commercial	50.8
Lower commercial	47.2
Servants	44.4
Artisans	41.7
Tradespeople	38.1

This ranking is not wholly what many would expect, and Saffiotti briefly discusses the causes of it, seeming inclined to give more weight to the non-hereditary than to the hereditary factors. He points to the intellectual interests and occupations that constitute the daily life of the professional classes, the intelligent but specialized outlook of the upper commercial and manufacturing classes, to which should be added the stimulus of keen competition; and the comfortable economic circumstances of the lower commercial class, with labor of a character that is somewhat favorable to the development of intelligence. In all these cases, he thinks, the environment is such as to produce bright children. For the relatively high standing of the children of the servant class, he seeks an explanation in

AN ENVIRONMENT FOR MENTAL STARVATION

No matter how much one may admire the development of modern industrial society, he can hardly believe that it offers a full and rich environment in which a child may "unfold," under such circumstances as are shown above. Even if a child had inherited ability (and many of the children who roam the streets have not) it could hardly be called into full play by the stimulus of a modern city street, which, compared with the country, offers little for a child to do. Much has been said of the evils of child labor, but under modern city conditions it is conceivable that child idleness may sometimes be equally injurious. Photograph by Milton Fairchild. (Fig. 8.)

the fact that they are in personal contact with people of a superior status and culture. The low standing of the offspring of tradespeople he attributes to "the constant contact with pettiness and poverty, the free roaming of the street and the uncontrolled participation in its gossip, license and freedom, the neglect of child welfare and of proper supervision and, frequently, the imitation of a bad example."

To many persons, these explanations will not be altogether convincing. It will seem more satisfactory to recognize more fully the differences in inherited intelligence. But Saffiotti's material is not sufficient to settle the problem, nor will any of the other studies here cited settle it.

2. At a school attended by the children of the rich in Brussels, Decroly and Degand found that the children were on the average a year and a half superior to the standard of their age, in

THE CITY TEACHES SELF-RELIANCE

It is very likely that the street gamin may be more self reliant, more assertive, more capable of looking after himself in some kinds of difficult positions, than a boy who has been more carefully nurtured. Such real benefit as life in the streets confers is mostly of this sort—a very different thing from real intellectual capacity. Parents who want their children to be well educated ought to provide them with such opportunities for developing self reliance and initiative as the boys of the streets have, but give them mental training of a more valuable kind at the same time. Photograph by Milton Fairchild. (Fig. 9.)

intelligence. Binet himself reviewed[2] these results, and concluded that they were due to a relation between intelligence and social status. He continues:

"There is a whole series of tests in which the advance is more marked than the others; and consequently, it is perhaps possible to deduce something interesting upon which aptitudes are most favored in the education of a rich child. *A priori* one would suppose that these children, little used to serving themselves, constantly surrounded by willing servants, would be more awkward with their hands than future workmen. But without making suppositions let us see what the facts reveal."

As a fact, these children were found to have done particularly well in arranging a series of weights in accordance with their real value. On the whole, Binet decided that their superiority was in those traits in which proficiency was favored either by attention (3 tests), home training (4 tests) or language (6 tests); the last point was the most conspicuous, the children of the upper classes being able to understand and to express themselves more readily than the average at an early age.

3. Morlé studied thirty children from one of the poorest schools in Paris, and an equal number from a wealthy school,[3] and found a difference of $\frac{3}{4}$ year, on the average, between the intellectual standing of pupils of the same chrono-

[2] Binet, Alfred. The Development of Intelligence in Children, pp. 316–322. Vineland Training School, 1916.

[3] Binet, *op. cit.*, pp. 326–328.

LEARNING HOW TO GET ALONG WITH OTHERS

The boy of the city streets becomes a "good mixer," and this probably makes him appear to have greater ability than he really possesses. Psychological tests have almost uniformly shown him to have less real intelligence than boys of the class who are kept more closely at home. It is, therefore, necessary to suppose that boys of the street have either been brought up in conditions which were unfavorable to the development of intelligence, or have failed to inherit good intelligence. There is unquestionably some truth in both of these ideas. Photograph by Milton Fairchild. (Fig. 10.)

logical age. Of the thirty wealthy pupils, sixteen were ahead of their age, while only five in the poorer school were advanced. The better group showed four backward children, the poorer group twelve.

A GERMAN INVESTIGATION

4. Teachers in the Breslau (Germany) schools compared pupils in the Volkschule, attended by the poorer classes, and the Vorschule, whose pupils come from the ranks of the well-to-do.[4] The 9-year-old boys in the former were, in intelligence, 10% inferior to boys of the same age in the latter, while ten-year-old boys in the poorer school were equal only to 9-year-old boys in the richer school. It was suggested that children of the higher social classes mature earlier.

5. Three groups of pupils, each containing about seventy individuals of both sexes and the same age, were compared by J. and R. Weintrob. Group A belonged to the wealthy class,

[4] This and the two following studies are taken from a review by Bridges and Coler in the *Psych. Rev.*, January, 1917.

had had the advantage of travel, etc.; the fathers of this group were nearly all American. Group B was mostly of German and Italian parentage; the fathers were wage-earners or small business men. Group C was made up of the children of a Hebrew Orphan Asylum who had had, strictly speaking, no home environment. In the various tests of intelligence group A was first but the Hebrew orphans of Group C were a close second. Group B was last. The investigators say, "Judging from the results environment does not seem to affect greatly mental capacity, if at all." If that is true, then the differences of intelligence of the children must be due to inherited differences, partly racial, in the various social classes.

6. Children (all white) in the city schools and in the schools of the mill district in Columbia, S. C., were tested by Miss A. C. Strong. Approximately the same course of study was presented in both schools. None of the mill children was above his age level, but 10% of the city children were. Less than 6% of the city children, but 18% of the mill children, were retarded at least one year.

7. Yerkes and Anderson tested fifty-four children in the kindergarten and first grade of a "favored" Cambridge (Mass.) school and an equal number from a school whose children had a much lower economic and social status.[5] They found that at and about the age of six years, the "favored" children did from a quarter to a third better in the tests than the "unfavored" children.

THE COLUMBUS INVESTIGATION

8. Bridges and Coler tested 301 children in two schools of Columbus, Ohio, by the point scale.[6] School A was in a very desirable residential district, the fathers mostly being professional or prominent business men. The other school, B, was in a poor factory district, where half the fathers were unskilled or casual laborers, many of the mothers worked, and half the families were recipients of some kind of charity. In both cases, however, all of the children were American-born of English-speaking parents.

The children in A were found to be from 21% to 32% superior to those of B; for a constant chronological age of pupil, there was a constant difference of two years in mental development. This difference was mainly in the tests demanding the higher mental functions, such as analysis and abstraction. Measured by the ordinary standards, nearly one-third of the children in B school would have been judged feeble-minded.

In the better school, two groups of thirty pupils each were chosen on the basis of their father's professions, and compared as follows:

	Chronological age		*Mental age*	
Professional men...	7 yrs.	7 mos.	9 yrs.	8 mos.
Traveling salesmen.	7	7	9	3

That is, the offspring of the professional classes were found to be nearly half a year superior in intelligence to the children of traveling men. Two groups of seventeen each were compared on the basis of the following origin:

	Chronological age		*Mental age*	
Clerks............	7 yrs.	10 mos.	9 yrs.	1 mo.
Managers.........	7	8	9	5

The children of managers of business enterprises were two months younger in physical age, but four months older intellectually, than the children of clerks. A similar grouping in School B gave the following contrast:

	Chronological age		*Mental age*	
Skilled labor......	7 yrs.	11 mos.	7 yrs.	6 mos.
Unskilled labor....	8	1	6	11

There were thirty-six children in each of these groups. Both were retarded. The children of unskilled laborers were chronologically two months older than their associates, but mentally seven months younger.

The authors make no attempt to

[5] Yerkes, Robert M., and Anderson, Helen M. Social Status and Mental Capacity. *Journ. Educ. Psych.*, March, 1915.

[6] Bridges, James W., and Coler, Lillian E. The Relation of Intelligence to Social Status. *Psychol. Rev.*, xxiv, pp. 1–32, January, 1917.

decide whether these differences in level of intelligence are due to differences in heredity or in home training and surroundings. They do say, "The superiority of the better classes is most evident in tests that involve higher mental processes like analysis and abstraction; but it is also shown to a lesser extent in sensory-motor functions."

"If mental age rather than chronological age were used to determine the time for beginning school," they add, "the children of the professional group, for example, would begin school two years earlier than the children of the unskilled labor group; for the former mature intellectually much earlier than the latter." In fact, if the children of unskilled laborers were judged by the standard of the professional group, a majority of them would have to be called feebleminded. This, however, the authors say, is not a fair standard by which to judge them: they should rather be judged by the standard of their own group.

CONCLUSION

9. In conclusion, it appears that there are very considerable differences in the natural intelligence of children, depending on the social and economic status of their parents. These differences might be due to home training, surroundings, association with superior people, etc.; or they might be due to actual differences in inheritance of intelligence, which training and education cannot obliterate. There is a good deal of evidence, which need not be reviewed here, to prove that the latter supposition accounts for a large part of the differences.

Eugenics seeks to increase the reproductive rate of the superior part of the nation, and decrease that of the inferior part. It is of great importance that more studies like the above be made, which will show just what parts of the population are, intellectually, superior, and that it be definitely determined to what extent these differences are innate.

But even in advance of this, eugenic effort is not at all premature. It is probably safe to say that those who are successful in life are, on the average, eugenically superior to those who are unsuccessful: that is it better to encourage those who are able to support themselves than those who, because of some physical or mental defect, are unable to support themselves and are a burden on the community. This distinction alone is sufficient to justify the proper kind of eugenics propaganda, and will furnish ample occupation for eugenists for some time to come.

Methods of Investigation in Applied Sociology

Eugenists have frequently had occasion to condemn much of the evidence by which students of public health, social betterment and euthenics support their conclusions. Faulty logic and incorrect statistical methods vitiate a great deal of it and have led too frequently to the ignoring of the biological foundations. In recent years more trained men have been going into the work of organized charity, and have done much to reform the methods of investigation. But the need for more care, and the ways in which it can be applied, are still too little recognized, and the Russell Sage Foundation (130 E. 22d St., New York) has done a service in publishing a pamphlet (price 20 cents) containing papers by Donald B. Armstrong, Franz Schneider, Jr., and Louis I. Dublin, with the general title "Methods of Investigation in Social and Health Problems." A study of this pamphlet is recommended to everyone who is interested in intelligent social betterment; it will shake his faith in much of the work that has hitherto been done by euthenists, but will give him an understanding of the exact methods by which such investigations must be conducted, if they are to furnish the basis for effective reform. Eugenists, too, can learn much which will make their own work stronger.

URBAN STERILIZATION

Effect of City Life in Cutting Down Increase of a Superior Population Is Shown by New Figures—Native-Born American Stock Fails to Hold Its Own in Most Parts of the United States

THAT the natural increase of city populations is much slower than that of country districts has long been well known.

If there is a constant removal of country people to the cities, if those who move are more energetic and capable than those who stay on the farm, and if this removal to the city results in a lower birth rate and a higher death rate, it is evident that great cities are a sterilizing agency, selecting the best part of the population and cutting down its racial contribution. Cook[1] and others have pointed out the importance of this eugenic problem.

It has been difficult to find statistics which would show the real size of the problem, but John M. Gillette, professor of sociology in the University of North Dakota, has lately made several contributions to the study which throw a great deal of light on it.

First as to the actual extent of migration from country to city. According to the census of 1890, 36.1% of the population of the United States was urban, that is, found in places of more than 2,500 inhabitants. In 1910 the urban population had increased to 46.3% of the whole. But this increase is by no means wholly due to migration from country districts, since the cities also grow by their own excess of births over deaths, by foreign immigration, and by incorporation of surrounding suburbs.

Between 1900 and 1910 the urban population of the United States made an actual gain of 11,826,000, and Gillette calculates[2] that 29.8% of this was made up of those who moved from the farm into the city.

The amount of rural depopulation is therefore considerable, even though less than has sometimes been supposed. The second question is how much the natural increase of these families will be cut down by their removal to the city.

Natural increase means the excess of births over deaths and is hard to calculate in the United States, because only a few states register births fully. But Dr. Gillette has reached a solution in several indirect ways and is convinced that his figures are not far from the truth. They show the difference to be very large and its eugenic significance of corresponding importance.[3]

"When it is noted," Dr. Gillette says, "that the rural rate is almost twice the urban rate for the nation as a whole, that in only one division does the latter exceed the former, and that in some divisions the rural rate is three times the urban rate, it can scarcely be doubted that the factor of urbanization is the most important cause of lower increase rates. Urban birth rates are lower than rural birth rates, and its death rates are higher than those of the latter."

Considering the United States in nine geographical divisions, Dr. Gillette secured the following results:

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[1] Cook, O. F., Eugenics and Agriculture, JOURNAL OF HEREDITY, vii, pp. 249–254, June, 1916.
[2] Gillette, John M., Constructive Rural Sociology (2d Edition), p. 89, New York, 1916.
[3] Gillette, John M., A Study in Social Dynamics: A statistical determination of the rate of natural increase and of the factors accounting for the increase of population in the United States. Quarterly publications of the American Statistical Association, n. s. 116, Vol. xv, pp. 345–380, December, 1916.

RATE OF NET ANNUAL INCREASE

Division	*Rural*	*Urban*	*Total*
New England	5.0	7.3	6.8
Middle Atlantic	10.7	9.6	10.4
East North Central	12.4	10.8	11.6
West North Central	18.1	10.1	15.8
South Atlantic	18.9	6.0	16.0
East South Central	19.7	7.4	17.8
West South Central	23.9	10.2	21.6
Mountain	21.1	10.5	17.6
Pacific	12.6	6.6	9.8
Total United States	16.9	8.8	13.65

Even though fuller returns might show these calculations to be inaccurate, Dr. Gillette points out, they are all compiled on the same basis, and therefore can be fairly compared, since any unforeseen cause of increase or decrease would affect all alike.

It is difficult to compare the various geographical divisions directly, because the racial composition of the population of each one is different. But the difference in rates is marked. The West South Central States would almost double their population in four decades, by natural increase alone, while New England would require 200 years to do so.

Dr. Gillette tried, by elaborate computations, to eliminate the effect of immigration and emigration in each division, in order to find out the standing of the old American stock. His conclusions confirm the beliefs of the most pessimistic. "Only three divisions, all Western, add to their population by means of an actual excess of income over outgo of native-born Americans," he reports. Even should this view turn out to be exaggerated, it is certain that the population of the United States is at present increasing largely through immigration and the high fecundity of immigrant women, and that, as far as its own older stock is concerned, it has ceased to progress.

To state that this is due largely to the fact that country people are moving to the city is by no means to solve the problem, in terms of eugenics. It merely shows the exact nature of the problem to be solved. A solution might be two-fold.

EUGENIC REMEDIES

1. Attempts might be made to keep the rural population on the farms and to encourage a movement of the superior elements (not the slum dwellers) of the cities back to the country. Efforts to improve rural conditions, economic and otherwise, and to secure a more general recognition of advantages of country life take on eugenic significance from this point of view.

2. The growth of great cities might be accepted as a necessary evil, an unavoidable feature of industrial civilization, and direct attempts might be made, through eugenic propaganda, to secure a higher birth rate among the superior families of the city population.

The second method seems in many ways the more practicable, since it is certain that great cities have come to stay, in the United States. On the other hand, the first method is in many ways more ideal, particularly because it would not only cause more children to be born, but furnish them with a suitable environment after they were born, which the city cannot do.

These suggestions involve the assumption that the birth rate of a family is directly affected by removal from country to city, and *vice versa*. It must be recognized that Dr. Gillette's statistics do not prove this assumption. They merely show that the country has a higher rate of natural increase than the city; this might be, and doubtless is, due to the interaction of a great number of psychological, physiological and racial factors. But it seems probable that the assumption made is true; that in some degree removal to the city does reduce the size of a family; and, contrariwise that removal to the country will increase the size of a family.

If this is true, then endeavors to colonize a lot of urban slum dwellers in the country, as by the Salvation Army and other agencies, are dysgenic, to the extent that these slum dwellers represent inefficiency due to inherent defect. Every effort should be made to reach the superior part of the population, in either one or other of the two ways suggested.

In practice, the problem will undoubtedly have to be attacked by eugenists in both of these ways. Dr. Gillette's statistics, showing the appalling size of the problem, ought to be a stimulus to eugenic effort.

DEGENERATE PLANTS

When Widely Different Varieties or Species Are Crossed, the Extreme Variants in the Second Generation Are Frequently Either Dwarfs or Giants, and in Both Cases Lack Reproductive Power—Notes from the Breeding-Ground

Byron D. Halsted
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THE term "degenerate" is, of course, one that does not admit of a clean-cut definition, and therefore it is here employed in a somewhat general way for those plants that show some weakness that interferes more or less with their successful struggle for life.

A gathering up of these notes was suggested by a recent study of results obtained from the breeding of musk-melons and therefore some observations drawn from these crosses, with photo-engravings, may serve as more than an introduction.

The chief combination we have made among the melons has been between a standard type, the Burrell Gem, and a recent novelty of the dwarf group, the Henderson Bush. The cross was secured in only one direction, namely, the vine upon the bush, all reciprocal attempts being failures otherwise than in emphasizing the fact that breeding is not effected with equal ease in both directions among diverse types of plants.

In the F_1 there were sufficient plants grown to make it clear that there was no observed effect of the bush upon the offspring so far as size of the plant is concerned. It is, however, possible that any restraining influence of the bush may have been offset by the stimulation that is generally ascribed to a cross in its first generation.

In the F_2 the plants were of the distinct parental types without any tendency to produce intermediates; in other words, there was an expression of the Mendelian ratio in the following figures: standards 69.2%, dwarf 30.8%.

Fig. 11 shows, upon the left hand, a portion of a vine plant coiled upon itself to bring it within the allotted space, while to its right is practically the whole of a bush plant, the leaves having been removed from both specimens that the character of the stems may be better seen. The eye quickly catches certain marked differences in detail, as, for example, the comparatively long, slender internodes in the vine type in striking contrast with the short and thick ones of the bush plant. The few remaining young leaves do not indicate the large difference in size in the mature foliage.

STEM THICKENS SUDDENLY

Attention is invited to the slender base of each branch in the bush plant. For one or more internodes the stem is similar to that of the vine but as soon as the region of bloom is reached, the internodes remain short and take on a remarkable thickening. The practical utility of the long, slender, basal internodes is not far to seek, for by this method of growth the extremely leafy portion of each branch is carried farther from the center of the plant and from the shade produced by the foliage of the main stem.

O. F. Cook[1] has suggested the term Brachysm for this shortening of the internodes as above mentioned, and is of the opinion that it is not an example of the beginning of a new character, although of much interest in the study of heredity and evolution.

The records show that the average weight of the ripe fruits from the vine plants was 692.2 grams and from the

[1] Brachysm—A Hereditary Deformity of Cotton and Other Plants. O. F. Cook, Journal Agricultural Research, Vol. III., No. 5, 1915.

TWO TYPES OF MUSKMELON

At the left is a standard vine type (Burrell Gem) coiled around itself, at the right a dwarf novelty, the Henderson Bush. The form of the latter is really degenerate, the stem being shortened and thickened in most of its length; and the fruits produced are as degenerate as the plant. Many of the most valuable commercial varieties of fruit and vegetable, and still more ornamental plants, are degenerates from an evolutionary point of view, and would not survive long in a struggle for existence with their wild relatives. (Fig. 11.)

bush plants only 199.2 grams. This is a remarkable positive correlation between size of plant and that of its fruits. Furthermore, the majority of the ripe fruits from the vine plants had salmon flesh like that of the vine parent, while the small fruits, few in number, of the bush plants were with one exception green fleshed, like the Henderson parent. In other words, there was an apparent linking of the factors for weight and flesh color (and shape as well) that may be attributed in part at least to the lack of vigor in the bush type. Whatever caused the brachysm, it may be assumed, acted to restrain the development of the fruits as well as the internodes; this influence extended even to the ripening of the melons and found expression in the failure to take on the salmon flesh-color characteristic of mature fruits of healthy, vigorous plants.

A form of degeneracy quite comparable with that shown in the muskmelon is found among commercial varieties of peppers that are grouped for this reason under the name of "clustered peppers." Plants in this category have very short internodes in the portion of the stem where flower buds form. This occurrence brings the forming leaves close together as well as any fruits that may afterwards form among them. These clustered leaves form usually long petioles with narrow blades, thus producing two types of foliage upon the same plant. Furthermore, the abortive stem, failing to continue its elongation, must rely upon the clustered leaves for photosynthesis and these are as a rule long-lived, take on an unusual thickness, and consequently become of a rich dark green color.

The Red Cluster is a common com-

mercial fascicled pepper and has been freely used in the breeding work of the experiment station. In the Golden Queen, a standard yellow-fruited sort, there are many characters that pair well with those of the Red Cluster. Thus the Cluster is a small, low plant with long, narrow leaves, and the fruits are small, upright, slender and hot; while the Queen makes a tall, much-branched plant with large normal leaves and bearing large, pendent, yellow, sweet fruits. These facts are mentioned to show that along with the chief distinction of internodal growth are a number of other opposing characters and confirm the opinion that the cross between these two kinds of peppers is a fairly wide one.

It was comparatively easy to secure combinations of the Queen upon the Cluster, but the large number of attempts to get the reciprocal have failed excepting in rare instances, and this work has been repeated each year for several seasons. The few plants that have formed the F_2 of the Cluster upon the Queen have exhibited a mixture of the two types of internodal growth (normal and brachysm), usually formed but few flowers of abnormal structure from which fruits rarely grew and these were seedless or nearly so. All attempts to breed these plants with the parents varieties have failed.

It is noted that the direction of this cross is the same as that in which no cross was obtained with the muskmelons, namely, the degenerate upon the normal type.

Many thousands of plants have been grown in the first five generations of the cross of the Queen upon the Cluster and, so far as the brachysm is concerned, conform closely to the rule of a Mendelian recessive; that is, it did not appear in the F_1, but practically in the ratio of one to three in the F_2. It might be remarked in passing that these crosses as grown in the seedbeds for setting in the field rarely showed any indication of brachysm, that is, the young plants were normal in stem- and leaf-development up to the place where the first flower bud is to form. If the setting were delayed until the plant bloomed, the grower would be able to eliminate the degenerates.

MANY ABNORMALITIES

In the F_2, for example, a field of a few thousand plants presented all imaginable combinations of the various characters of the parents in their association with brachysm; some of them were pitiable or amusing as the observer may decide. For example, there were low, unbranched plants with the stem ending in a single sphere of large, broad leaves the tips of which reach down to the ground all around the plant, the whole suggesting a dust mop. Within this head of foliage there may be a fruit or so of the Queen type pendent and sadly cramped and distorted by its fellows. Again the plant may have formed a large head from which stems emerged and ended in heads of leaves and fruits like the one from which they came, and in turn sent up normal stems that repeated the clustered habit of growth, so that a "three-story" plant may be seen at the close of the season. Brachysm is so closely associated with flower bearing that when the vegetative functions only are active the stems and leaves are normal.

The crosses in question show that when the fascicled type of foliage expressed itself there were associated with it more or less fully those characters common to the Red Cluster parent, namely, small size of plant and fruit and non-prolificness; and here, as has been noted with the muskmelon, there seems to be a causal relation that needs to be borne in mind by those who would deduce rules of breeding from such degenerates.

Figure 12 shows one of the dwarf pepper plants upon the left in striking contrast with the standard type of the same cross that occupies the main portion of the engraving.

In breeding tomatoes many unusual plants have come to light. For example, several years ago, while breeding the Dwarf Champion with Golden Sunrise to obtain a beautiful blush-cheeked kind (an *ignis fatuus* perhaps, long since abandoned), an F_2 plant was obtained, among hundreds of the normal type, that attracted much attention because

DWARF AND STANDARD PEPPER PLANTS

At the left is a dwarf plant of full size, bearing ripe fruits; beside it is a normal plant of the same cross. The two were photographed as they stood in the field. These dwarfs are degenerates which appear in crosses made in commercial strains of plants; sometimes they are of value to the gardener, but more frequently not. (Fig. 12.)

of its extreme size, the crinkly type of leaf and its few small and nearly seedless fruits. This plant has become the parent of a race of tomatoes that under the name of Oligosperm has bred true within itself but does not unite with other kinds. The attempts to combine this mutant with various commercial varieties have failed and, so far as breeding goes, it seems to be outside the scope of the tomato expert.

In the above instance it appears that we have a degenerate that is primarily characterized by its great size. The interest that centers in the possible behavior of its yet unknown offspring from union with its allies can be imagined, for it does not conform to the type of abnormality that has been here considered in the muskmelon and the pepper. In the present instance the unusual nature of the outcrop is to be seen in the peculiar cotyledons and many minute details of the growth of the giant, and it is placed here among the degenerates because of the extreme weakness of its reproductive organs (that may have a causal relation to its vegetative vigor) and its lack of sexual affinity with plants that are its closest kin.

Within recent years and in connection with other tomato crosses similar abnormal plants have appeared, but the

lack of reproductive power has prevented their continued propagation and crossing with ordinary plants.

DEGENERATE EGGPLANTS

In the breeding of eggplants there have appeared plants that may deserve a place among the degenerates. Here as in the last mentioned cases the abnormal individuals have come from parents that conformed to the usual type but were in combinations between well-marked species and not the more simple crosses of commercial varieties. For example, when the *Solanum melongena* is bred with *S. integrifolia* there results at once a set of unexpected giant plants that are very much larger than either parent, and as a rule bloom profusely but form fruit at rare intervals. Many plants, the largest ones, are entirely barren, while the smaller specimens produce enough seeds for the continuation of the stock. Unlike the Oligosperm these degenerates are less infertile and have frequently been bred with their parents.

In the F_2 of the eggplant hybrids there is a range of plants all the way from dwarfs that are bloomless to giants with countless flowers but nearly fruitless, as in the F_1. Here the extremes represent the two types of deficient plants. The union that brought the series into existance was obtained with much difficulty and is not looked for in a state of nature, while should it occur there are reasons for expecting that it would soon disappear as lacking the qualities that make for a continuation of the species.

The Prairie berry (*Solanum nigrum*) in the hands of the breeder has behaved in a manner that suggests a notice here. Dr. Groth had the type species and the green-fruited variety in the breeding grounds for years, and the crosses which were secured after a very long series of failures exhibited a variety of forms that seemed to be limited only by the number of individuals grown. Thus, from normal parents there was obtained a small percentage of dwarfs of two sizes, the smaller being only 5 cm. in height. There were upright plants and those that remained prostrate upon the ground. They varied in shape and size of leaf, flower and fruit, the latter being black, green or piebald when ripe; some very acid, others sweet, etc. As a rule the Prairie berry is a selfed species and it has been determined in many instances that the F_2 type is perpetuated with a fair degree of uniformity.

Here, as among other subjects in this paper, the degenerates are the extremes among the progeny, namely, the remarkable dwarfs usually with few or no fruits and the largest plants bearing almost no seeds. It is likely that the latter are big because they are barren. A series of tests has been running for several years to demonstrate the effect of the prompt removal of all flowers as they appear upon normal plants, and the results show that the natural life of the deflowered plant is prolonged and the size much augmented.

From a study of mounted plants in the larger of American herbaria it is evident that the species under consideration is remarkably variable, although no dwarfs were found. It seems to be probable that interbreeding infrequently takes place in nature and because of the selfing habit many types are widespread. The dwarfs, while they may make up a small fraction of the wild plants, would be passed by as unworthy of consideration by the collector.

SURPRISES FROM BEANS

The breeding work with beans has been fruitful in obtaining results that warrant mention here. For a time surprises attended each step, particularly as to the range of possible unions. Selfing prevails among the several species and natural crosses between different varieties of the navy bean (*Phaseolus vulgaris*), while they occasionally occur, are quite exceptional. Failure has attended all the many attempts to breed between certain species of the genus, as, for example, the Lima and snap beans. With the Scarlet Runner (*P. multiflorus*) the results have been more successful and it is of these unions among beans that mention is here made. E. J. Owen, who has immediate charge of the breeding with beans, has been unable to get hybrids in both directions, and

only a very small percentage of the attempted combinations of the Scarlet Runner upon bush snap beans have been successful. It should be stated that only a small percentage of the blooms of a Scarlet Runner inflorescence produce pods and therefore hope still lingers that by multiplying the attempts success may be achieved.

These hybrids have been in the breeding grounds for several years and they follow the general rule of producing in the F_2 an extremely wide range of plants. For example, there were dwarfs, some of them so small as to attain only a few inches in height, with the small leaves near each other, and producing no flowers. Other plants went to the opposite extreme in size and spread out in all directions from the tip of a tall pole, abounding in blooms and yet yielding no fruits. During the last season there was a block of a hundred hills of this hybrid and no two plants were alike in all respects. A majority of the set did not produce seed but there were a number in the intermediate class that were fairly prolific. In years past plants of remarkably high productive power have been selected and continued through some generations with the prolificness unimpaired. From all the light that has been thrown upon the subject by long association with these hybrids it seems probable that the factor for seed-production will be inherited with some degree of uniformity where the plants are left to their own devices.

Again, it is noted that a union made between two species is followed by the production of a set of offspring a number of which answer to the general meaning of degenerates, and, furthermore, these deficient plants are of two opposite and extreme types, namely, those of feeble growth and unusually weak in reproductive power, and, secondly, the giants of the cross that while surcharged with vigor as expressed in unlimited growth are barren or nearly so.

WEAKNESS OF SWEET CORN

The above instances do not by any means exhaust the list of defective plants that have come from the work in breeding. In fact, a large part of the researches has been with crosses of plants that already have a weakness and in so far are degenerates. A most familiar instance is the sweet corn. Here the mother plant lacked the active factor of storing an ample supply of starch in the maturing kernel and the offspring must do as best it can with the sugary content of the grain. It is a well-understood fact that such shriveled corn is comparatively low in viability, and when the soil is damp and cold may fail to produce plants where the common type of grain thrives. When the two last named types of corn are bred together there is frequently a large percentage of the F_1 plants that are albinos and therefore fail to mature. The same is true of the crosses of the Cuzco with our largest types of field corn, and further, it was found that the plants, while as a rule of strikingly large size, were entirely unprofitable for crop-production. This albinism may be only partial, the plants outgrowing the weakness; and, furthermore, this defect is sometimes racial in corn as for example the variegated kinds that are grown for ornament. A study of these latter kinds leads to the opinion that as a rule they are of low stature and produce few and small ears. It is well to rank such varieties as degenerates, for they produce a large percentage of plants with deficient vigor and it would be a disadvantage to have them reproducing in a field of normal corn.

Many variegated ornamental plants are recessive to the solid green or normal chlorophyllous plants. Some breeding work is now in progress with nasturtiums in which it is shown that the varieties with the dark green leaves are dominant in that character over those with pale green foliage, and both of these are dominant when bred with the variegated sorts. In other words, the kinds least fit to use the sunlight in their life processes are recessive. The same rule holds with peppers that have pale green leaves and unripe fruits and no exception, as far as is recalled, has been met with on the breeding grounds.

In passing it might be mentioned that the wrinkled peas are comparable with sweet corn in the failure of the seeds

to lay down a normal supply of starch and the seeds are of comparatively low viability. Other kinds have the legumes and surrounding stem devoid of the normal supply of chlorophyll (wax-podded). These sorts, with us, have been noticeably weak in stem, requiring tying to stakes at frequent intervals, yield but few seeds and breed with much difficulty. All such plants that lack the full complement of nourishment in the seed and chlorophyll in the plant are poorly equipped for the struggle of wild life.

In the same category is included the large group of wax-beans also recessives to their green-podded relatives. Here the failure to produce chlorophyll does not extend far beyond the pods and the vigor of such varieties is not greatly diminished.

The above observations have been drawn from the records of breeding work that has been carried on for other purposes than the particular study of degenerates. It seems to me that the degenerates, as they have been used in the work, are not forceful as compared with the normal type. The appearance of unfit individuals seems to result from the breeding together of kinds that are not congenial because of one or more of many possible reasons. Such unions are forced and the greater the lack of consanguinity, within the comparatively narrow range of possible union, the larger the number of defectives. These misfits belong to the two extremes of a large series of types, namely, those that show from the start a feebleness that results in restricted growth and reproduction; and secondly, those in which excessive vegetative vigor is associated with partial or entire barrenness. Such unions are vital to the progress of our knowledge of heredity, but along with the creations of great value there are obtained many defectives that from the practical side need to be surpressed.

WORTHLESS NOVELTIES

No thoughtful person would decry the widest possible breeding among plants in order that the range of unions may become well known, but at the same time a novelty does not spell superiority and it calls for true courage upon the part of the originator to cast the bulk of his pets into the burn heap.

When a plant having an inherited deformity or weakness is bred with the normal type its abnormality usually enters into the union as a recessive and is subject to great modifications through future generations. Records show that there is a linkage or coherence between the dependent characters in the degenerates of the cross; *e. g.*, size of fruit and size of plant.

Such breeding, because of the many failures, calls for much patience, and one is fortunate in getting the union reciprocally.

Recessives when the characters involved are related to plant stamina as lack of size, of chlorophyll, or of fruitfulness are weak, and in so far are unfit, but this does not include the great mass of recessives as regards form of flower, fruit and seed, etc.

Unless the degenerates are grown for the special character that is their weakness (such commercial strains are numerous and valuable), they might well be kept from mingling with the healthy types.

The Extremes of Intelligence in School Children

Not far from 2% of the children enrolled in the public schools must be looked upon as real defectives, according to Prof. Lewis M. Terman of Stanford University (*The Measurement of Intelligence*, 1916). The number of children with very superior intellectual ability is approximately as great as the number of feebleminded, he thinks; and upon this superior 2% "the future welfare of the country hinges in no small degree." He finds that teachers usually overestimate the intelligence of the inferior children and underestimate the intelligence of the superior ones. There is great need for the use of reliable mental tests in education, if the children of superior ability are to be recognized and given the opportunities which they deserve.

AN OFFICE-HOLDING FAMILY

Descendants of One Massachusetts Man Have Held an Unusual Number of Offices of Public Service and Trust Through Six Generations—Eugenic Significance of Such a Pedigree—Genealogists Should Pay More Attention to Civic Worth in Their Histories

Merton T. Goodrich, *Jay, Me.*

In a monarchic country, office-holding tends to be a prerogative of families which have wealth and social position. It has not necessarily a very high correlation with eugenic worth. But conditions in a democracy are different. Here, the candidate for office is judged very largely on his own merits. When a local, non-partisan office is to be filled, the voters almost invariably consider the qualifications of the candidate and care very little about the record of his father. Even in partisan politics but little is said concerning family history. While it cannot be said that the best qualified man is always the one elected, while it may be admitted that factors outside of personal worth sometimes influence the result of an election; it is true that in a democracy the people will not allow a man to remain in an elective office for long unless he is superior in some way to his competitors. Therefore, if a family in the United States should possess for several generations many members who had held local, non-partisan offices and served for a long time in these positions, it would seem to be something worthy of study from a eugenic point of view, it might indicate the inheritance of certain traits which the people expect such officers to possess.

While compiling the genealogy of a certain New England family, I found a large number of members who had held public office. I shall present the facts in this paper, and point out some of the ways in which I think they have eugenic bearing.

The family is of Anglo-Saxon origin, the several lines of ancestry having been traced back to English immigrants who settled in Massachusetts between 1630 and 1640. So far as can be learned these ancestors were no different from the majority of Puritans. None of them held public office.

THE FIRST GENERATION

Our study begins with a man whose paternal grandfather came from Suffolk County, England, in 1634. His wife's father and grandfather came together from Southampton in 1635. He moved with his family from the town in which he was born to a town in the central part of Massachusetts. He was one of the first settlers of this town and was active in bringing about its incorporation. He was elected to several town offices but lived only nine years after he moved there. There were twelve children in the family. all of whom lived to grow up. Of the seven boys, five held town offices, one of them being town clerk twenty years and chairman of the board of selectmen thirty-eight years, but of the public life of the other two nothing is known. Public officers are also to be found among the children and descendants of the five girls who married men of more or less local prominence. In fact, throughout the genealogy, the presence of office-holders among the female branches seems to be nearly, if not quite, as common as among the male branches. This may be accounted for to some extent by assortative mating such as that just noted.

Office-holding certainly cannot be spoken of as an inherited trait. The facts available do not even disprove that it is wholly a matter of education and environment, to one who leans toward that explanation. But the fact that a large proportion of the members

of this family, for generation after generation, occupied public offices seems to me to indicate that they possessed certain inherited abilities and dispositions which favored public service.

The majority of the offices held by the members are those of selectman, town clerk, town treasurer, school-committeeman, minister of the gospel, physician, and teacher. While the last three positions are not strictly public offices, they are positions of public service and as such need to be included in the list. Only those who made teaching a profession are listed as teachers. I include also minor offices such as constable, tax collector, and justice of the peace. A few members of the family have held State and national offices, but a far greater number have held offices of purely local influence and non-partisan character. The nature of the offices indicates the presence of a spirit of public service rather than one of political ambition, an interest in local matters rather than a broad grasp of national affairs. The exceptions to these characteristics are found in those cases where the members have had superior education.

FEW ACQUIRED WEALTH

There is nothing in the constitution of New England society which would oblige the members of the family to take up, in so many instances, labors which were arduous and which brought little—in many cases no—remuneration. It is further interesting to note that there is scarcely an individual in the whole genealogy who possessed even a moderate amount of wealth.

Office-holding in this family is, therefore, not part of the tradition of a wealthy, governing class, as it might be in England. It is not a means of getting rich. It is apparently due to some peculiar mental characteristics and I believe that these include a certain amount of intelligence, conscientiousness, altruism, probity, and industry, with a lack of competitive aggressiveness and the commercial spirit.

The presence of these characteristics is further emphasized by the large number of male and female teachers in the younger generations. Indeed, teaching is practically the only position of public service in which females could make manifest the possession of these characteristics. Undoubtedly, many individuals who possess these traits were barred by sex or some other cause from filling the positions they were by nature qualified to fill. The trait of lack of aggressiveness, if stronger than the others, would overcome them, and prevent an individual who had inherited these traits from holding public office and from being included in the records among those possessing the family traits. It is evident, then, that the percentage of public officers shown by the tables underestimates the prevalence of these traits.

The mental qualities which I have mentioned have hereditary bases of some kind. So although office-holding is not to be considered an inherited trait, it seems to me reasonable to think that there are inherited traits particularly favorable to it, and that they were inherited with considerable persistency in a family which, in a democratic country, furnished so many men and women for positions that meant public service with hard work and little pecuniary reward.

FULLER DATA NEEDED

It may be of interest to note that among the descendants of the relatives of the founder of the family occasional instances of office-holding have been found, but the instances are too scattered and the data too incomplete to make possible the drawing of a definite conclusion. The scarcity of data in most genealogies in regard to the public life and traits of different individuals is a great handicap in studies of this kind. I believe that the need of recording complete data in regard to the mental, moral, and physical characteristics of individuals as well as the facts of birth, marriage, and death can not be pointed out too strongly to genealogists. I believe also that female branches should be treated with the same completeness as male branches and with as full a bibliography as

possible of the data concerning the female branches published in other genealogies. It is a matter of good fortune that through the coöperation of members of this family who are interested in genealogy and through the assistance of town clerks in the study of their records, I was enabled to obtain fairly complete data in regard to this family.

The recent history of the family is of some interest. After the Revolution in which at least one son and four grandchildren of the founder were engaged, several descendants migrated from Massachusetts to Maine, New Hampshire and Vermont. It will be remembered that the founder helped incorporate a Massachusetts town. A grandson was influential in bringing about the incorporation of a town in Maine of which he was one of the first settlers. Between 1830 and 1860, many members of the family went west. Eighteen members of the family are known to have served in the Civil War. Of these, eight were killed—all young men of promise including a young surgeon and a captain. After the Civil War the number of emigrants was greatly increased, until now the descendants of the family are to be found in nearly every northern State.

There is no evidence to show that this family is superior to others of similar composition. Doubtless other families might in some cases show the inheritance of the same traits and possess a correspondingly large number of public officers. The accompanying tables show the amount of public service performed by this family:

In this table (I), the per cent of members holding public office is shown to have decreased from generation to generation. I am not certain as to the true explanation of this fact. While it must be largely due to the increasing size of the generations, there may be genetic factors involved. It seems possible that the members of the second generation inherited from both parents certain traits not particularly strong in themselves, but which by combination produced a strong group of transmissible characteristics made manifest by office-holding; and that this group of traits has in the successive generations been made weaker and weaker by the introduction of inherited traits of an opposite nature. The small number of individuals recorded in the seventh generation is due to the fact that this generation is too young to have many members which have reached maturity.

An interesting thing to be noted in the second table is the decrease in the number of selectmen and town clerks and a corresponding increase in the number of teachers and physicians in the younger generations. This is suggestive, but the figures are hardly sufficient to warrant a general conclusion. The large number of minor officers does not indicate a preference for that kind of office, because a very large number of those who filled minor offices afterward filled more important ones. The number of female teachers is additional to the number of public officers, all of whom are males. It is obvious that the same individual frequently held several offices, at the same or different times.

TABLE I.—*Public Life*

	Generation							Total
	1	2	3	4	5	6	7	
Mature males	1	7	28	47	61	125	33	302
Public life known	1	5	21	42	57	94	24	244
Public officers	1	5	17	21	25	29	7	105
Per cent	100	100	81	50	44	31	29	43

Table II.—*Nature of Offices*

	Generation 1	2	3	4	5	6	7	Total
Public officers	1	5	17	21	25	29	7	105
Town clerks	0	3	1	1	4	2	0	11
Selectmen	1	3	3	4	7	4	0	22
Town treasurers	0	2	2	1	0	2	1	8
School-committeemen	0	0	0	1	4	3	1	9
Minor town officers	1	3	15	17	13	16	2	67
State or national	0	0	0	1	1	1	0	3
Ministers	0	0	1	4	4	3	0	12
Physicians	0	0	0	1	4	3	3	11
Male teachers	0	0	0	0	0	2	4	6
Duplicates	1	6	5	9	12	7	4	44
Female teachers	0	0	1	5	6	9	2	23

Table III.—*Inheritance of Traits*

	Generation 1	2	3	4	5	6	7	Total
Public officers	1	5	17	21	25	29	7	105
Neither grandfather nor father an officer	1	0	0	0	0	0	1	2
Grandfather an officer but father not	0	0	0	2	5	5	0	12
Father not an officer	1	0	0	2	5	5	1	14
Connected by the mother	0	0	6	5	2	9	1	23
Father an officer	0	5	11	14	18	15	5	68
Three generations of officers	0	0	8	9	12	8	2	39
Four generations of officers	0	0	0	9	12	8	2	31
Five generations of officers	0	0	0	0	12	8	2	22
Six generations of officers	0	0	0	0	0	8	2	10
Seven generations of officers	0	0	0	0	0	0	2	2

In the above table, the number of officers shown connected with the family by the mother is much smaller than that connected with the family by the father, but this is largely due to the incomplete data concerning some of the female branches. It should be noted that whenever three consecutive generations have been public officers, all the direct ancestors back to the first individual have been public officers.

Table IV.—*List of More Notable Members*

1. Two Representatives to the United States Congress, both serving several terms.
2. A delegate to the provincial congresses at Concord and Cambridge.
3. A clerk of courts, serving 16 years.
4. Selectmen and town clerks with long terms of office, usually held at the same time:
   (*a*) Selectman, 10 years.
   (*b*) Selectman, 22 years; town clerk, 15 years.
   (*c*) Selectman and town clerk, 36 years, died in office.
   (*d*) Selectman, 22 years; town clerk, several years.
   (*e*) Selectman, 19 years; town clerk, 17 years.
   (*f*) Selectman, 8 years; town clerk, 20 years, now in office.
   (*g*) Selectman, 38 years; town clerk, 20 years.
5. School-committeemen with long terms of office:
   (*a*) School-committeeman, 12 years.
   (*b*) School-committeeman, 27 years; stated that he had rather be a member of the school committee than be President; died in office.

(*c*) School-committeeman, 56 years; also taught 97 terms of school.
6. Postmaster, 44 years; member of New Hampshire legislature several terms.
7. Pastor of one church for 40 years.

It is a matter of some importance to eugenics to know whether a stock has small or large variability. The Jews, for instance, as Dr. Maurice Fishberg has pointed out, have produced an exceptional number of eminent men, but at the same time they have produced an exceptional number of mental and physical defectives. No such condition exists in this family. Its record in each generation has been about the same. None has been rich, but none has ever been a pauper or a criminal. None has been a genius, but there is no record of feeblemindedness, and only four cases of insanity among the 803 individuals recorded. These cases occur in the fourth and fifth generations, one each, and two in the sixth generation; the three latter cases being in a female branch. The records of some 500 descendants of brothers, sisters, and cousins of the founder of this family show also an absolute lack of extremes. In this respect the family contrasts with some of the more famous New England families.

TABLE V.—*Maturity*

	Generation							Total
	1	2	3	4	5	6	7	
Members	1	12	61	110	170	323	126	803
Maturity known	1	12	61	108	165	315	80	742
Matured	1	12	56	85	128	238	62	582
Per cent	100	100	91	78	77	75	77	78
Males	1	7	31	60	86	171	44	400
Matured	1	7	28	47	61	125	33	302
Per cent	100	100	90	78	71	73	75	75
Females	..	5	30	48	79	144	36	342
Matured	..	5	28	38	67	113	29	280
Per cent	..	100	93	79	84	80	81	82

TABLE VI.—*Longevity*

Age at death	Public officers		Mature males not officers		Mature females	
	Number	Per cent	Number	Per cent	Number	Per cent
90–99	3	0.029	1	0.007	7	0.025
80–89	11	0.105	2	0.014	20	0.071
70–79	17	0.162	4	0.029	24	0.086
60–69	9	0.086	13	0.093	16	0.057
50–59	4	0.038	8	0.058	9	0.032
40–49	1	0.009	6	0.042	12	0.043
30–39	2	0.019	10	0.072	20	0.071
21–29	0	0.	10	0.072	11	0.040
Living	23	0.219	45	0.324	65	0.232
Unknown	35	0.333	40	0.289	96	0.343
Total	105	1.000	139	1.000	280	1.000

Another matter of vital importance is to know to what extent valuable intellectual and moral traits are correlated with valuable physical traits. If the production of intelligence is encouraged, will that also encourage the production of sound children, or the reverse, as some who do not understand eugenics pretend? Again, Alexander Graham Bell has been advising that much weight be placed on family longevity in the choice of a mate; will or will not long-lived people be found to be above the average of the population in mental ability?

These are questions which must be answered fully, and on which there is now very little light. As I have pointed out, this family is not characterized by extreme mental development. It seems to be about the average in this respect. In the matter of physical development, some of the family histories make record of the fact that the men were large and well proportioned, the most striking record being that of a man, his brother, and two sons, who together measured 25 feet. On the other hand, several members of the family are known to have been smaller than the average. In these cases, however, the small stature can be traced to a parent who did not belong to the family. The extent of my study is too small to carry much weight, but the figures in regard to maturity and longevity are suggestive.

In the general population of the United States, at the present time, about 80% reach maturity (21 years). In an earlier period, the percentage who did so is known to be considerably smaller, but I am unable to present any figures that would be of value for direct comparison. I think the conclusion is justified, however, that the child mortality in this genealogy is not above the average; I am of the opinion that it would be found, on proper investigation, to be somewhat below the average.

It is well known that low infant mortality, and longevity, are correlated, both being due to the inheritance of a sound constitution. It is therefore to be expected that the family should show a large proportion of long-lived members. The greater number of long-lived males among the office-holders than among those who are known to have followed other careers is interesting but not conclusive. Most positions of public service favor long life, because they do not entail any particular exposure or risk. Further, the office-holders are a doubly selected lot: first, because one is usually not elected to office under 30 years of age, and the weaker members of the family by that time may have died; and second, because only men of strong vitality and endurance would take many of these offices, which meant work without pay outside of the individual's regular employment. But even allowing for these factors, there is indication (as one would *a priori* expect) that longevity is correlated with superior mentality and morality.

In sum, this family is marked by a tendency on the part of the males, and to a less extent the females, to choose occupations that are of the nature of public service. It is also marked by a good average of physical soundness, intelligence, and economic efficiency, with no great deviations from the average. It seems in some degree to meet the standard of "civic worth" on which Galton laid stress as an element of eugenics.

A TASK FOR GENEALOGISTS

One of the greatest difficulties which eugenics faces is that of deciding which part of the population is the valuable part whose increase should be encouraged at the expense of others. The general tendency is to make financial success the criterion, but this is not free from objection. Its great merit is that it is an easy test to apply; but it can be argued that financial success depends as much on opportunity as on ability; and that it sometimes represents cunning and selfishness, rather than constructive, altruistic traits. Without necessarily admitting the truth of these objections, one must recognize that the financial criterion is not perfect. It seems possible that genealogists, if they had the needs of eugenics in mind, might be able to supplement this criterion with others. If many families, or even considerable

strata of the population, could be found in which the members were marked by general physical, mental, and moral soundness, and by a spirit of public service rather than merely by one of money-getting, it ought to be possible to promote the fertility of such families by eugenic measures.

It is with the hope of stimulating genealogists to work from the point of view of civic worth, that the present paper is published.

THE INHERITANCE OF ARITHMETICAL ABILITIES

IT IS no longer possible to doubt that mental capacities are inherited, but the analysis of them is extremely difficult. Does a child inherit general arithmetical ability, for example, or is ability in subtraction different from ability in addition; or are all sorts of arithmetical ability merely due to the amount of training given to some more general form of intellectual capacity? Margaret V. Cobb has been studying this particular problem, and presents a preliminary report in the *Journal of Educational Psychology* (viii, pp. 1–20, January, 1917).

The abilities she considers are addition, subtraction, multiplication, division, and speed in copying a column of figures.

"The measurements made show that if, for instance, a child is much quicker than the average in subtraction, but not in addition, multiplication or division, it is to be expected that one at least of his parents shows a like trait; or if he falls below the average in subtraction and multiplication, and exceeds it in addition and division, again the same will hold true of at least one of his parents." These various kinds of arithmetic appear to be dependent on different functions of the brain, and are therefore probably inherited independently, if they are inherited at all. Furthermore, the inheritance must be segregating. All the children of the same family do not always resemble the same parent.

To assume that the resemblance between parent and offspring in arithmetical ability is due to association, training and imitation, is not plausible. If this were the case, a class of children ought to come to resemble their teacher, but they do not. Moreover, the child sometimes resembles more closely the parent with whom he has been least associated in daily life.

The details of Miss Cobb's study, which was made by means of correlations, cannot be conveniently summarized. They seem, however, to bear out her conclusion that heredity plays at least a considerable part in determining a child's ability at various arithmetical processes.

Lectures on Heredity in Washington

A course of three lectures on heredity was given by the Washington Academy of Sciences this spring, as follows:

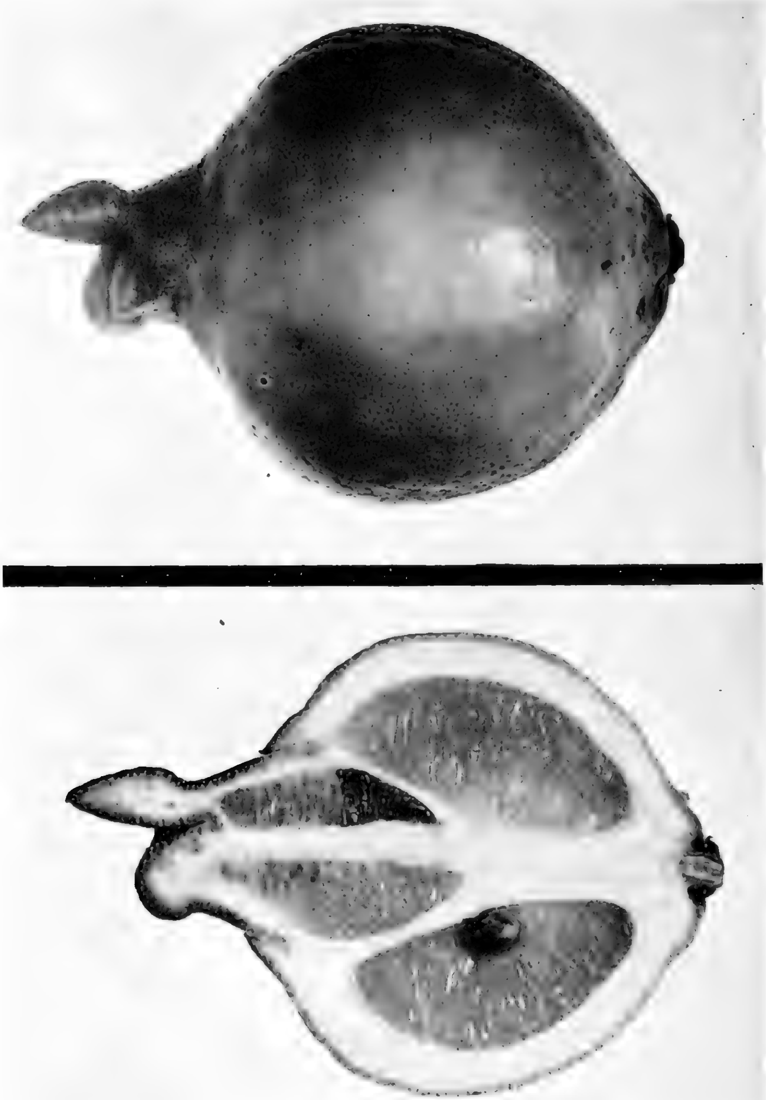
Prof. H. S. Jennings of Johns Hopkins University: Observed changes in heredity characters in relation to evolution. March 15.

Dr. Oscar Riddle, Carnegie Institution (Cold Spring Harbor, L. I.): The control of the sex ratio. March 29.

Prof. W. E. Castle, Bussey Institution, Harvard University: The rôle of selection in heredity. April 13.

These lectures are published in the Proceedings of the Washington Academy of Sciences, and can be obtained separately. Dr. Frederick Wright is secretary of the Academy.

A LEMON BUD VARIATION



The occurrence of navel fruits is rather common in citrus varieties. Frequent examples of such fruits have been found in the individual tree performance record studies of some of these varieties, other than the Washington navel orange, in California and elsewhere in citrus districts. For instance, several grapefruits with well developed navels have been found in Marsh trees. In the Valencia orange studies many fruits have been found with navels, but none was absolutely seedless. In picking the performance record lemon trees in California, navel fruits have been found occasionally. The accompanying photograph shows (natural size) a navel lemon with a large protruding navel This fruit contained several seeds. It was produced by a normal tree bearing, except for this specimen, normal fruits. The trees of the Ruby Blood variety of orange, and the Dancy variety of tangerines, in California, produce very many fruits having navels. None of these fruits, however, that has so far been found by the writer, is seedless, or promises to be of any particular value commercially. They are interesting mainly from the standpoint of emphasizing the frequency of the occurrence of striking bud variations in citrus varieties. (Fig. 13.) —A. D. Shamel, Riverside, Cal.

HOW BEES RECOGNIZE EACH OTHER

THAT bees recognize each other principally by the sense of smell is the conclusion of N. E. McIndoo, of the Bureau of Entomology, who discussed the subject at the last annual meeting of the American Society of Zoölogists. Most of his conclusions are confirmed by the work of other students.

"It is certain," he says, "that a queen gives off an odor, and it seems reasonable that the odors from any two queens would be slightly different. All the offspring of the same queen seem to inherit a particular odor from her. This odor, called the family odor, perhaps plays little or no part in the lives of bees, for it is certainly masked by the other odors. Drones seem to emit an odor peculiar to their sex, but little can be said about it. It seems certain that each worker emits an individual odor which is different from that of any other worker. It is also probable that the wax generators and nurse bees emit odors slightly different from those of the field bees.

"Of all the odors produced by bees, the hive odor is probably the most important. It seems to be the fundamental factor or principle upon which the social life of a colony of bees depends, and perhaps upon which the social habit was acquired; without it a colony of bees could not exist. The hive odor is composed chiefly of the individual odors from all the workers in a hive, and is supplemented by the odors from the queen, drones, combs, frames and walls of the hive, etc. From this definition it is easily understood why no two colonies have the same hive odor. The hive odor of a queenless colony is perhaps considerably different from that of a colony which has a queen. The absence of a queen odor in the hive odor probably explains why the workers in a queenless colony are irritable and never work normally. All the bees—workers, queens and drones—of a colony carry the hive odor of that colony on their bodies among the hairs. This odor serves as a sign or mark by which all the occupants of a hive 'know' one another. Since the queen and drones are 'aristocrats' they seem to disregard the sign that has been thrust upon them, but whenever a queen enters the wrong hive, she soon 'realizes' that she wears the wrong badge. Worker bees returning to the hive from the fields pass the guards unmolested, because they carry the proper sign, although the hive odor that they carry is fainter than when they left the hive, and it is also partly masked by the odors from the nectar and pollen carried by these bees.

ODORS MAY CHANGE

"Bees kept in the open air for three days lose all the hive odor carried on their bodies, but each bee still emits its individual odor. When a colony is divided the hive odor in each half soon changes so that by the end of the third day the original colony possesses a hive odor so different from that of the other half of the colony, that when the workers are removed from the two new colonies and are placed together in observation cages, they fight one another as though they had been separated all their lives.

"While a foreign hive odor calls forth the fighting spirit in workers, the queen odor always seems pleasant to workers regardless of whether the queen belongs to their hive or to another hive. Even though the queen odor forms a part of the hive odor, it is probable that this odor to the workers stands out quite prominently from the hive odor. That workers do not miss their queen for some time after she has left the hive, indicates that her odor thoroughly permeates the hive odor and that whenever this odor grows faint the workers 'know' she is not among them.

"There has been much speculation concerning the ruling spirit or power in a colony of bees. The writer is inclined to believe that a normal hive odor serves such a purpose. The hive

odor is a means of preserving the social life of the bees from without, the queen odor which is a part of it ensures continuation of the social life within. As already stated the workers 'know' their hive mates by the hive odor they carry. This odor insures harmony and a united defence when an enemy attacks the colony. The queen odor constantly informs the workers that their queen is present, and even though she does not rule, her presence means everything to the bees in perpetuating the colony. Thus by obeying the stimuli of the hive odor and the queen odor, and being guided by instinct, a colony of bees perhaps could not want a better ruler."

BODY AND MIND

Those who are Mentally Defective are Likely to be Physically Below Par as Well—Methods of Diagnosis—Superiority of the Left Hand and Small Lung Capacity Marked in the Feebleminded

BY THE use of mental tests, an experienced examiner can usually tell without difficulty whether a child is feebleminded or has normal intelligence. Everyone understands that the two types of mind are different, even if these differences are not sharply defined.

But the differences are not solely mental. Many persons who have had to do with feebleminded children have recognized that they were abnormal in body, as well as in mind.

As early as 1892, Porter concluded from a study of 33,500 children that there is a physical basis of mental precocity, that dull children are lighter in weight than the average child, and precocious children heavier; that mediocrity of mind goes with mediocrity of physique.

Smedley announced that the "evolutionary ideal child stands somewhere above the average in each measurement." He found that children who were physically superior were quite regularly superior in school efficiency. This conclusion was confirmed by several investigators.

On the other hand, several investigators found that feebleminded children were below par physically. From a study of 6,000 feebleminded males and 5,000 feebleminded females of all ages, Goddard demonstrated that with but slight exceptions the feebleminded of both sexes are below the normal averages, and that the degree of subnormality bears a direct relation to the degree of mental defect, with the highest grades, the morons, closely approximating the normal.

Among the confirmatory studies is that of Mead, who concluded that "not only is mental defect reflected on the average in the height and weight of children, but the more decided the defect, the more checked the physical growth," a result which was more evident in height than in weight. Feebleminded girls are more like normal girls than feebleminded boys are like normal boys, in his opinion. Again, Baldwin affirms that "the majority of school children above median height are in or above normal grade and above the average in marks. Of those below median height the majority of children are below or in normal grade and below average mark."

The Training School at Vineland, N. J., has for the past ten years been making physical measurements of its pupils, recording the height (standing and sitting), weight, grip (right and left), and lung capacity. These furnished good material for a further study of the relation between physique and intelligence, and more particularly of the relation between the various measurements to each other, and E. A. Doll, assistant psychologist, has submitted the records to statistical treatment and recently published the results.[1]

[1] Doll, E. A. Anthropometry as an Aid to Mental Diagnosis. Publications of the Training School at Vineland, N. J. (Research Dept.), No. 8. February, 1916. Pp. 91, price 75 cts.

There are 477 sets of measurements from which those of children with physical defects are excluded. The results are expressed in coefficients of correlation.

Standing height.—The feebleminded of all grades are below normal[2] in standing height. There is a marked dependence of the degree of subnormality upon degree of feeblemindedness. The feebleminded not only grow tall at a retarded rate, but cease growing at an earlier age than normal children. There is naturally a good deal of variability, but the conclusion of other investigators is, in general, confirmed. Bright children tend to be taller than the average, and dull children shorter.

Sitting height.—This is consistently even more subnormal than standing height; that is, the feebleminded tend to be unusually long-waisted and short-legged. But the highest types, the morons, approximate the normal average. Of all feebleminded, 75% fail to reach the normal average.

Weight.—There is not such a marked connection here as in the height measurements. Among the higher grades of feebleminded, the boys are often normal and the girls above normal. In the lower grades, among idiots and imbeciles, weight is often considerably below par.

Right grip.—Barr has aptly said that strength of mind and strength of hand accompany each other. Only 10% of the feebleminded have a normal grip.

Left grip.—Goddard has for some years held that the feebleminded are markedly below normal in strength of grip, with left superior to right (even when they are not left-handed, in ordinary employments). Doll finds this conclusion borne out by the measurements. They do not show a tendency to ambidexterity, but toward actual superiority of the left hand, in all ages and grades of children. In low-grade individuals there is often almost no power of grip in tests, because of mental defect, although the individual may be physically strong and may handle a loaded wheelbarrow all day with ease.

Lung capacity.—This shows the greatest subnormality of all the measurements, only 8% of all feebleminded reaching the normal average. It is little connected with height or weight. It is so highly correlated with mental age ($r = .64$) that it alone could be taken as a fairly reliable index of mental defect. It is rather hard to apply, for the typical low-grade subjects are unaccountably timid in the experiment and often refuse to approach the instrument. The best of three trials was recorded in each case, but the pupil too often insisted on blowing through the nose, or on stopping the mouthpiece with his tongue.

Average.—None of these tests alone is a sure guide for diagnosis, but taken together they are, in Doll's opinion, of much value. Only 14% of feebleminded individuals come up to the normal average. Variability, however, is high. In individual diagnosis, considerations of race, nationality, heredity, environment, physiological development, health, exercise, physical defects, and special personal history must never be omitted.

One naturally wants to know whether the child is feebleminded because of his physical defects, or whether he is physically defective because he is feebleminded. But this question cannot be definitely answered, from the knowledge now available. Probably defects of both mind and body are due to very complicated processes of development involving the internal secretions, and neither is to be looked upon as the actual cause of the other. Doll takes pains not to express an opinion on this point, and to warn readers that his study is to be looked on only as preliminary, and intended only to supplement, not to supplant, the customary mental tests, in diagnosing feeblemindedness.

[2] The normal accomplishment of boys and girls of various ages, in these six tests, is shown in Smedley's percentile tables. These have long been out of print, and the Training School has done a service by republishing them as an appendix to the present monograph.

THE ESSENCE OF MENDELISM

JOHN BELLING, *Washington, D. C.*

MENDEL discovered the facts relating to the progeny of hybrids in rather complex cases. His method of exposition, beginning with more or less complex examples, has been followed to some extent in most text-books. But it is an advantage for the student to begin with the simplest case, as is shown below.

1. If we cross a purple-flowered pea with a white-flowered one, both belonging to true-breeding races, all the progeny (hybrids) no matter which way we make the cross, have purple flowers.

2. When we fertilize the white-flowered parent with hybrid pollen, on the average half the progeny have purple flowers and half have white flowers. Hence only half the hybrid pollen-grains carry something which makes the purple color appear.

3. When we fertilize the hybrid with pollen from the white-flowered plant, we get again on the average half purple and half white-flowered plants. Hence half the egg-cells of the hybrid carry something which makes the purple appear.

4. In cases 2 and 3 the purple progeny are found, as we would expect, to be all hybrids, *i. e.*, they are not constant in their own progeny but give both purple- and white-flowered plants.

5. When we cross a purple-flowering pea with green pods with a white-flowering pea with yellow pods, all the hybrids have purple flowers and green pods.

6. When we fertilize the white-flowered plant with hybrid pollen we get, on the average, plants in these proportions:

¼ purple flowers and green pods.
¼ purple flowers and yellow pods.
¼ white flowers and green pods.
¼ white flowers and yellow pods.

Hence, one-fourth of the hybrid pollen grains carry something (which we call for convenience a *factor*) for purple and green, one-fourth factors for purple and yellow, one-fourth factors for white and green and one-fourth factors for white and yellow. This is shown by testing the self-fertilized progenies, when it is found that all purples or greens are inconstant (hybrid), while all whites and yellows are constant. It follows: (*a*) that the factors for purple flower and white flower are independent of the factors for green pod and yellow pod; and (*b*) that it is the combination of *factors* which are hybrid, and *not the whole plant*.

Generally, if A, B, C, D, E, . . . etc., are symbols for n independent *dominant* factors (which show in the hybrid) and a, b, c, d, e, . . . etc., are symbols for the corresponding *recessive* factors in a second plant, then on crossing the hybrids and the recessive parent we get 2^n different combinations in equal numbers on the average, showing that the hybrids have 2^n different kinds of pollen-grains and egg-cells.

Thus the hybrid $AaBbCcDd$, crossed with the recessive $a_2b_2c_2d_2$ gives, on the average:

1/16 $AaBbCcDd$	
1/16 $AaBbCcd_2$	
1/16 $AaBbc_2Dd$	
1/16 Aab_2CcDd	
1/16 $a_2BbCcDd$	
1/16 a_2b_2CcDd	1/16 $a_2b_2c_2Dd$
1/16 a_2Bbc_2Dd	1/16 $a_2b_2Ccd_2$
1/16 a_2BbCcd_2	1/16 $a_2Bbc_2d_2$
1/16 Aab_2c_2Dd	1/16 $Aab_2c_2d_2$
1/16 Aab_2Ccd_2	1/16 $a_2b_2c_2d_2$
1/16 $AaBbc_2d_2$	

7. If we were to fertilize a hybrid plant with its own pollen, it is readily seen that the result would be the same, as regards one pair of factors, as if we used equal amounts of the pollen of its two parents. One-quarter of the progeny would be constant dominant, one-quarter constant recessive, and one-half hybrid. Similarly, the complicated formulas given by Mendel for two or more pairs of factors can be deduced without further experiment.

The

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CONTENTS

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WAS THIS THE FIRST FORM OF LIFE ON THE GLOBE?

Blue-green algae (Nostocaceae) such as are shown above, about 800 times natural size, are little different from bacteria in structure. They can live in hot springs and get their food exclusively from minerals. Euler suggests that they represent the earliest living thing in the world; if so, their spores must have been brought here from some other planet, propelled by waves of light. Unless they came from our own solar system, they must have travelled for at least 9,000 years before reaching the earth. Photomicrograph by John Howard Paine, from a preparation by H. L. Shantz. (Frontispiece.)

See "A Hit-or-Miss Universe," p. 320.

FEEBLE-MINDED IN OHIO

Survey of One County Shows That One Per Cent of Population is Mentally Defective—One Large Clan is Found to Descend From Marriage of an Immigrant With an Indian Squaw, Shortly Before Revolutionary War—Few of the Feebleminded are Properly Cared For

MINA A. SESSIONS
Field-worker, Bureau of Juvenile Research, Columbus, O.

ON MARCH 1, 1916, a survey of a rural county in Ohio was begun by the Bureau of Juvenile Research, to discover the extent and social significance of feeble-mindedness in that particular part of the state. The county chosen as the subject of the survey is situated in what is known as the hill section bordering the Ohio River, and on July 1, 1916, had an estimated population of 54,389. There are but two cities in the county, each of which has a population of between six and seven thousand. Along the bottom lands of the streams there is good farm land but because of its rough surface the larger part of the county is not suitable for agricultural purposes. Coal mining is the principal industry of the county.

The field work was done and a detailed report of findings has been prepared by the writer. She worked in the county studied from March 1 to December 20, 1916 and sought information in each township, first of all from the public schools, and then from the physicians and township trustees. The county institutions were visited and the county and city officials, the one district nurse, the one social worker, and many private citizens were interviewed. When cases of feeble-mindedness were discovered in the schools or reported from other sources, their homes were visited and information obtained concerning their personal and heredity histories. This procedure frequently led to the discovery of other feeble-minded persons who were in turn followed to their homes.

In general no formal intelligence tests were given, but the suspected cases were judged on a sociological basis with possession of ability or inability to maintain existence accepted as the essential difference between the normal and the feeble-minded person. The definitions of the English Royal Commission of 1904 were adopted as the standard. It was recognized that the environment in which many of the inhabitants of the county lived was a simple one, and for that reason a lower degree of mentality was sufficient to maintain a satisfactory existence than would have been the case in a more complicated environment.

In the various state institutions there were, on March first, two hundred and fifty-three persons from this county of whom forty-one were known to be feeble-minded. Only twenty, or less than half, of these were in the Institution for the Feeble-minded. Four were in one of the State Hospitals and the remaining seventeen, most of whom had been given formal intelligence tests, were in penal or correctional institutions.

In the County Infirmary there were found sixty-seven inmates. Of these, thirty-two individuals, or 47.7% of the total Infirmary population, were dependent on the county because their mentality was so low that they were unable to maintain themselves independently in the community at large. Eleven individuals, or 16.4%, were there because they had so broken down their physical and mental health by the excessive use of alcohol that they were no longer able to make their own way in the world at large. It is probable that some at least of these alcoholics could also be classed as feeble-minded since

A HOME OF THE HICKORIES

To this shanty in an Ohio city, an elderly man of the Hickory family, a great clan of defectives in rural Ohio, brought his girl-bride, together with his two grown sons by a former marriage. The shanty is 6 by 10 feet in size and contained a bed, table and stove. It was conveniently located at a distance of 100 feet from the city dump, where the family secured its food. The oldest son has been in the county infirmary and two younger children are in an institution. The whole family is feebleminded. The attention of the city authorities was called to this establishment when one of the sons was accidentally shot; the family was then forced to leave, but was afterward reunited. Such a family is incapable of protecting either itself or its neighbors, and should be cared for by the State. (Fig. 1.)

their inability to keep from becoming alcoholics may have been due to mental defect. Only twenty-four individuals, or 35.8%, were dependent because of some infirmity due to old age or illness.

RESULTS OF TESTS

Formal intelligence tests were made of the children in the County Children's Home and of the one hundred and one children in the Home at that time ten, or 9.9%, were feeble-minded. When this is compared with the percentage of feeble-minded children in the public schools of the county, it is seen that there is proportionately five times as much feeble-mindedness among the dependent children in the Children's Home as among the public school children.

Two hundred and ninety-seven teachers in one hundred and seventy-two separate school buildings were visited, or practically every grade teacher in the county. Of 8,930 school children enrolled, one hundred and sixty-four, or 1.8% of the enrollment, were found to be feeble-minded. In the urban schools, 0.8% of the children enrolled were feebleminded while in the rural districts 2.1% were feeble-minded. Or, in other words, the proportion of feeble-minded school children in the country districts was two and one-half times greater than it was in the cities.

A special study was made of two

THE HOUSE IN THE HOLLOW

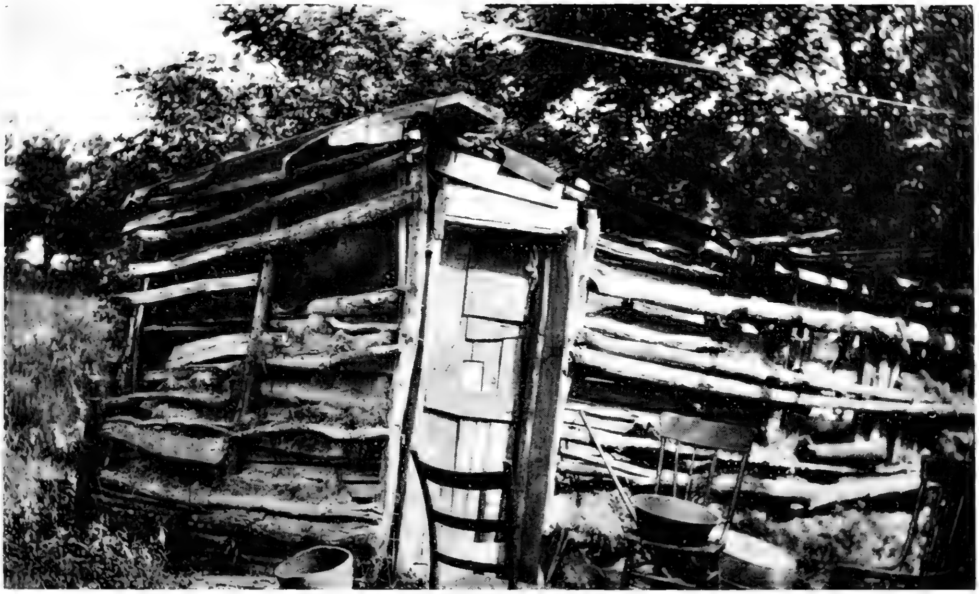
In this log and pole cabin, built by a feebleminded Hickory man and his two sons, thirteen persons lived, all sleeping in a single room without any windows. A double bed, a single bed and a trundle bed were all the sleeping accommodations available. Members of a family like this, which is characterized by hereditary feeblemindedness and constant dependency, are not useful citizens, yet they are increasing in number every year, under the present regime of public indifference and careless charity. (Fig. 2.)

rural schools where a large number of feeble-minded were found. Every child in the two schools was given an intelligence test in order to verify the judgment of the field-worker. There were thirteen children in the first district school, of whom six, or 46%, were feeble-minded; two, or 15%, were borderline; and five, or 38%, were of normal intelligence. The six feeble-minded children included two brothers and two cousins, while the two borderline cases were sisters of one of the cousins. The district in which this school was situated was an old mining village where the mine had been abandoned and the more industrious part of the population had moved to a region affording better industrial advantages.

The second district school studied had thirty-one children enrolled. Of these, thirteen, or 42%, were feeble-minded; eight, or 26%, were borderline; and ten, or 32%, were of normal intelligence. This district was a rural community where most of the inhabitants owned small pieces of land and worked in the mines. The homes were situated along a creek between two high ridges. There were twelve family names in the school of thirty-one children. Nine children, only one of whom was feeble-minded, belonged to five different families and were in no way connected with other families in the valley. The remaining twenty-two children had seven family names, each one of which stood for a defective strain. Members of five of these families had married back and forth freely.

A CHIEFTAIN OF THE HICKORY CLAN

[illegible] Hark [illegible] son and heir of [illegible] children, applied for admission to the County [illegible] generation after generation [illegible] family has been the [illegible] Hark [illegible] and duplicated his [illegible] father [illegible] children, [illegible] feeble-minded) are [illegible] great [illegible] increasing every year, [illegible] even of counting the [illegible] 70 [illegible] of age [illegible] has never done any work except [illegible] dependent on charity. (Fig. 3.)



A TYPICAL HICKORY RESIDENCE

When Elliott Hickory married, an aunt furnished land on which he built the shanty shown above. He got it up as far as the roof and then quit work, owing to lack of funds and inclination. After suffering the chagrin of seeing her daughter live in a roofless house for some time, Elliott's mother-in-law finally took in washing and secured enough money to buy tarred paper for a roof. She sent Elliott into town to purchase this, but he returned with a jag instead of with tarred paper. The mother-in-law thereupon raised another roofing fund, and spent it herself. But after the house was roofed, Elliott found it uncongenial, and has spent nearly all his time visiting various relatives, taking his wife with him. He is distinctly feeble-minded, and in the present ignorance of public opinion, this fact probably will ensure his leaving a large posterity to perpetuate his name and mental traits. (Fig. 4.)

There were found at large in the county, including school children, four hundred and ninety-four feeble-minded persons, which is equivalent to 0.9%, or nine to every thousand of the population. Twenty-one of these were idiots, one hundred and twenty-six were imbeciles, and the remaining three hundred and forty-seven were morons. Cards with short social and heredity histories for each one of them are on file at the office of the Bureau of Juvenile Research, together with four hundred and ninety-six other cards with similar information on the inmates of the county institutions and such anti-social persons or probable cases of feeble-mindedness as were brought to the attention of the field worker.

Of the four hundred and ninety-four feeble-minded persons at large, four hundred and fifty-seven were born in Ohio and three hundred and seventy-one of these, or 75% of the total, were born in the county in which they are now living. The great majority of cases were descendants of pioneer stock which came from Pennsylvania, New York, and the New England States. But two or 0.2% of the feeble-minded persons at large were born in other countries, while according to the last census, 5.3% of the population of the county was foreign born. Eighteen others, or 3.6% of the feeble-minded persons, were of foreign or mixed parentage, while at the time of the 1910 census, 9.2% of the population of the county were native born of foreign or mixed parentage. Thirteen of the four hundred and ninety-four persons were negroes. In 1910, 2.6% of the popula-

tion of the county were negroes, and thirteen is just 2.6% of four hundred and ninety-four. So that the large number of feeble-minded now in the county cannot be laid to the negro race nor to the immigrants, but rather to the deterioration of the native stock, or else the perpetuation of the mental defects of the old stock.

In the study of the feeble-minded at large in the county, the fact was brought out that there were proportionately just twice as many in the rural districts as in the cities; also that the mining districts had a much larger proportion of feeble-minded than the agricultural districts. This last fact is probably partly due to the geographical characteristics of the mining districts where the hills are so steep as to be entirely unsuited for agricultural purposes, and for that reason most of the land belongs to the coal companies, thus affording space where defective families may build their shanties and live undisturbed. Another causative factor is that defectives may work in the mines more profitably than on farms because steady work is not required and many opportunities are afforded for working under direction in jobs that make no call on initiative.

A careful comparison was made of the number of feeble-minded in each township and the average amount of township aid given yearly in those townships. It was found that where the proportion of feeble-minded at large in the community was high, the amount of aid given was correspondingly high and where the proportion was low, the amount of aid given was correspondingly low. There seemed to be a direct relationship between the two factors.

As has already been mentioned, heredity histories of varying thoroughness were obtained for all of the feeble-minded in the county. Seven families were found to which belonged 144 feeble-minded persons, or 26.8% of the total number of feeble-minded now living in the county. Of this number, twelve were in the county institutions and 132 were at large. Seventy-eight of these feeble-minded persons, five in the county institutions and the others at large, or 14.5% of the total in the county, belonged to a highly inbred family of defectives which has been called the Hickory Family. Sixty-two separate Hickory families were found living in the county of whom forty-eight were centered in one township. It was discovered that all were descended from a common ancestor who came to America from a French port in the days preceding the American Revolution. He married an Indian squaw and settled in the back woods of Pennsylvania. His six sons and one daughter emigrated to Ohio about the year 1800 and took up land near each other bordering a creek. Descendants of five of these children are now living in the county studied. The oldest of the brothers, who has been called Happy Hickory, was undoubtedly feeble-minded. Seventy-five of the seventy-eight feeble-minded Hickorys now in the county are lineal descendants of this man. Thirty-five of these, because of the close inter-marrying, are also lineal descendants of some one of his sibs. A summary of the 401 descendants of Happy Hickory has been made. Eighty-seven, or 21.8%, of these did not reach an age beyond fourteen years. One hundred and forty, or 34.9%, could not be classified because of lack of information or youth. Of the remaining 174 who reached an age beyond fourteen years and about whom definite information was gained, 51.1% were known to be feeble-minded and another 17.8% are suspected of having been so.

AN INBRED FAMILY

This family is highly inbred, probably partly because of the geographical features of the township in which they live, which is the one having the steepest hills and the most inaccessible ridges in the county, and also because they are largely ostracized by their neighbors, both of which factors tend to limit selection of mates. Of eighty-nine marriages shown on the chart made of Happy Hickory and his descendants, fifty, or 56%, are cousin marriages of varying degree, ranging

A HOME THAT SHOULD BE BROKEN UP

In this cabin live two of the Hickories (second cousins) and their two young children. Both husband and wife are decidedly feebleminded, and it is certain that all their children will be. It is sometimes a crime for society to break up a family; but it is unquestionably a crime for society *not* to break up this one, segregating the members for life. (Fig. 5.)

from double first cousins to third cousins. Twenty-one of the marriages are between persons closer of kin than second cousins, and twenty-one others are between second cousins.

The most prominent characteristic of the family is their absolute dependency. Thirty-three of the forty-eight Hickory families living in the one township received township aid during the fiscal year June 30, 1915 to June 30, 1916. Twenty-three of the direct descendants of Happy, together with four relatives in collateral lines, have been in the county infirmary. An old record, dated a short time after the infirmary was opened in 1857, reads, "Hank Hickory, his wife, and seven children applied for admission. Were not allowed to stay by the directors." The first inmates of the county children's home, when it was opened in 1878, were three Hickory children transferred from the county infirmary. Twenty of the direct descendants of Happy Hickory and twelve others in collateral lines have been in the children's home.

Members of the family also have thieving and immoral habits which, together with their habit of dependency, make them most undesirable persons to have at large. The cost of the family to the community in public support and private charity as well as by petty thieving, the breaking down of moral standards, and the spreading of infection, especially trachoma and venereal diseases, cannot be estimated. And no doubt the adjacent counties, where other Hickory families are living, have to bear a like burden.

SUMMARY

Therefore, to summarize, 20 feeble-minded persons from this county are in the institution for the feeble-minded, and 21 in other State institutions. Thirty-two are in the county infirmary, 10 in the children's home, and 494 at large in the county, making a total of 577 feeble-minded persons having a legal residence in the county, which is equivalent to 1.06%, or 10.6 persons to every 1,000 of the population.

Although 83, or 14.3%, of the total number of feeble-minded are in various institutions, only 20, or 3.4%, are properly segregated in an appropriate institution, the institution for feebleminded.

If we assume that 1% of the population of the entire State is feeble-minded, it means that Ohio has within its borders some 47,000 feeble-minded persons, of whom only 2,200 are now properly segregated. However, a fairer way to estimate the total number in the State would be by other surveys in other representative parts of Ohio. The county which has been surveyed is probably representative of the hilly counties in the southeastern part of the State. The fact that one feeble-minded man left at large five generations ago is responsible for seventy-five feeble-minded persons living at the present time makes one pause to wonder what the condition of things will be five generations hence, if the present generation and their descendants are allowed to reproduce their kind. However one looks at the matter, it is evident that if the problem of control of the feeble-minded is to be met by segregation, provision in Ohio must be made on a much more extended scale than is at present contemplated.

Some Eugenic Aspects of Military Registration

Selective draft in the United States will produce such far-reaching effects that everything connected with it should be scrutinized carefully by eugenists. It is of the utmost importance that men should not be sent to the front who will be more useful at home, and this means that many of the best educated men of the nation should be exempted. These men, however, having less frequently dependents, are the least likely to claim exemption, as is shown by the figures for registration in Pittsburgh. In four of the wards that are among the poorest in the city, eugenically, the proportion of exemptions claimed is 58.2%, while in four of the best wards it is 50.5%. Of the total white registration, 60.5% claimed exemption, whereas of the total colored population 66.7% claimed exemption. In such a case, the attitude of the exemption boards is all-important, and it is to be hoped that men will be appointed who will realize the eugenic as well as the military needs of the country. In this connection the attitude of some of the registrars was very offensive: Three men of my acquaintance were bulldozed out of making a proper entry of their occupation. Fortunately, the stupid rather than the intelligent men would be most often victims of such tactics.

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Eugenics and Military Pensions

The question of pensions after the war was discussed by Major Leonard Darwin, president of the Eugenics Education Society, at the Galton Anniversary meeting in London, Feb. 16. He pointed out that the soldiers and sailors are in many respects a superior lot of men, on the average; and that those who were wounded are likely to be, eugenically, superior to those who were not. These two facts, he thought, should be borne in mind when pensions are allowed. He commended the provision which awards an allowance for each child of a pensioner, but condemned the limitation which excludes children born after the pensioner left service. In the interest of eugenics, he thought an allowance ought to be given for each child, no matter when born; and for this purpose the allowance given to a childless wife might be reduced. Furthermore, he thought that those who were pensioned because of tuberculosis and similar defects should be given less encouragement, provided it were shown that such defects had a hereditary basis. In short, one of the objects of the pension system should be to encourage the better men, and those only, to have large families after the war.

LARGE FAMILIES

In Normal Stock, Those of Nine and Ten Children Are Found by Alexander Graham Bell to Show the Fewest Premature Deaths and the Largest Percentage of Longevity—Family of from Six to Eight Children Seems to be Most Favorable to Longevity of Mother—Conclusions Drawn from Slum Statistics Are Misleading

THOSE who preach birth control are responsible, it is to be feared, for the gradual creation of an idea that large families are an evil. This idea is false and dangerous. For the sake of eugenics, it is important that it be not spread. It is being created by such statements as the following:[1]

> Unregulated childbearing means a progressive decline in the mother's health accompanied by progressive debility in her offspring.
>
> Ample proof of this statement—if proof were needed for such a simple truth—is furnished by the investigation conducted by Dr. Alice Hamilton into the child mortality among 1,600 families in the Hull House district, Chicago. It was found that, as the number of children increases, the death rate goes up, so that in families having eight or more children, for example, the mortality among them is two and one-half times as high as in homes where the number of children does not exceed four.
>
> Similarly, tables compiled by the Children's Bureau at Washington in its "Johnstown Survey" bring out graphically the grim fact that the large families lauded with such vociferousness by the advocates of large armies only serve to fill the ranks in our hospitals and the rows in our graveyards.

The two studies quoted deal with large families in a class of the population characterized by economic straits and frequent destitution. If a father is barely able to support two children with the necessities of life, if the children inherit from both parents inferior physique, if the parents are deficient in intelligence, it is pretty certain that frequent childbirths will mean frequent child deaths *for that family*. In such a family it would be much better if only a few children were born.

But to argue from such a case that large families in any class of the community mean progressive debility in offspring is certainly illogical.

In fairness it must be said that those who preach the desirability of few offspring do not always make this argument directly. More frequently, perhaps, it is only inferred from their statements. Constant repetition, without qualifications, of the declaration that large families mean high infant mortality and weakened children, naturally creates the impression that such a statement holds good in all classes of the population. It is the purpose of this note to sound a warning against such a misunderstanding. Large families in the slums may be considered undesirable; unregulated child-bearing for any woman may even be considered undesirable; but this does not make it undesirable to know the biological facts about large families, separated from the influence of poverty.

It is doubtless true that in the Hull House district, where many children have feeble and unintelligent parents and lack the necessities of life, a large family means weakness. But the reverse is true in normally sound stocks, in sections of the population which have average intelligence, physique, and prosperity. Abundant evidence could be cited to support this statement. One of the most striking bits is that recently worked up by Alexander Graham Bell.

Dr. Bell has for some years been making a study of facts contained in the published genealogy of the Hyde family in America, with special reference to the longevity of its members. One of his more recent tabulations[2] shows the duration of life of sibs (full brothers and

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[1] Birth Control Review, 1, p. 12. New York (104 Fifth Avenue), February, 1917.

[2] The data can be found in the Beinn Bhreagh Recorder (xx, p. 201), a copy of which is on file at the Smithsonian Institution. Dr. Bell is preparing to publish the whole investigation shortly. Thanks are due to him for permitting this use of his figures in advance of publication, and to Sewall Wright for preparing the two graphs.

sisters) compared with the number of them in each family.

This table (I) deals with 2,964 individuals. If a random sample of a hundred be taken, and the career of each one followed, their history will be represented by the graph in Fig. 6. The very large and very small families are at the sides, the middle-sized families in the middle of the figure, and it is evident that the larger and smaller families had a relatively large death rate in childhood and early youth and a smaller proportion of members living to old age.

"ONLY CHILD" CARRIES HANDICAP

In the forty-one cases set down as "only child" a majority (58.5%) died young. If the families containing only two children be added, it is found that no less than 47.6% of the total (126) died before reaching maturity, and only 4.8% lived to be over eighty.

There were 168 persons belonging to very large families containing thirteen or more children. No less than 46.4% of these persons died in childhood (under twenty) and 5.9% lived to be over eighty.

It is evident that in this case both too few and too many brothers and sisters were unfavorable to long survival.

The proportion who died young was least, and the proportion who lived to be old was greatest, where the persons belonged to families containing nine and ten children. There were 683 such persons; 32.8% of them died young, and this is the smallest proportion dying under twenty of any of the groups shown in Table I. On the other hand, 9.7% of these persons lived to be over eighty; and this is the largest proportion living to old age in any of the groups shown in Table I.

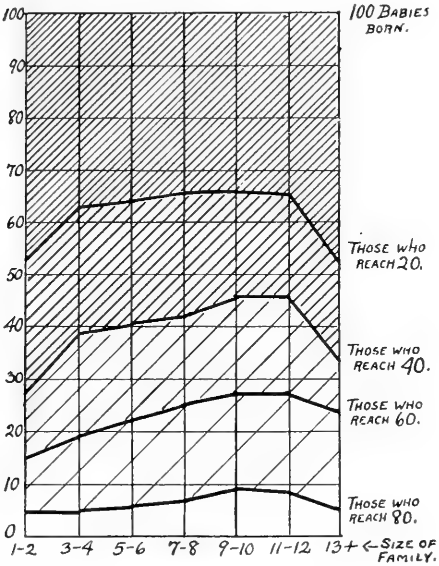
In short, the proportion of children who lived to old age increased with the size of family up to ten children, and beyond that it fell. There thus seemed to be a limit to the size of family consistent with the production of long-lived offspring, but this limit is very much higher than popular ideas would lead one to believe. Certainly ten children constitute a pretty sizable family; even the most enthusiastic eugenist is not likely to ask superior mothers to have as many offspring as that. Nevertheless the child with nine brothers and sisters has (statistically speaking) just about twice as good a chance of living to old age as has the child with only a single brother or sister, in a normal, healthy population.

But if the analysis of the figures is carried a step further, an even more striking result appears. It is evident from Fig. 6 that the greatest difference between the families of various sizes is in the amount of child mortality. It is important to know how the various sizes of family will rank, if differences in

TABLE I.—*Duration of Life of Individual Compared with the Number of His Sibs; Percentages Who Died at Ages Named*

Number in family	Total persons	Ages at death				
		20	20–40	40–60	60–80	80+
1	41	58.5	22.0	4.9	9.7	4.9
2	85	42.4	24.7	18.8	9.4	4.7
1 and 2	126	47.6	23.8	14.3	9.5	4.8
3 and 4	313	36.1	25.5	19.2	14.4	4.8
5 and 6	584	35.5	24.5	18.3	15.9	5.8
7 and 8	694	33.0	25.2	17.7	16.9	7.2
9 and 10	683	32.8	22.2	17.9	17.4	9.7
11 and 12	396	33.6	21.2	18.4	17.9	8.9
13 and more	168	46.4	17.3	13.1	17.3	5.9
	100.0%	35.2%	23.4%	17.7%	16.4%	7.3%
	2964	1044	693	525	486	216

child mortality are eliminated. To show this, Dr. Wright has prepared Fig. 7, in which only those individuals who reached the age of twenty are considered.



HISTORY OF 100 BABIES

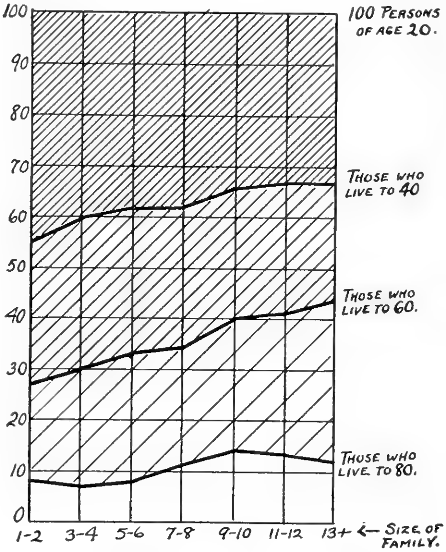
The top of the diagram shows the children "starting from scratch." By following down the vertical lines, one can see that their longevity depends largely on the size of family from which they come. Those who had ten or a dozen brothers and sisters are most likely to live to extreme age. (Fig. 6.)

LARGEST FAMILIES GAIN

Comparison of this with the preceding graph shows at once that the small families are still handicapped, but that the largest families have made a gain. A family of ten children is no longer the most favorable one; the families of thirteen and more have just about as large a proportion of members living to an advanced age. The bigger the family, the better off are its members, if survival beyond the age of twenty be the measurement, as in this case.

It is evident, then, that the small families (though they are not very small, either, by present-day standards) make the poorest showing under all conditions; their members are handicapped at all ages. The larger families—those around ten children—make the best showing at all ages, few of their members dying young and many living to old age. Children in the very largest families suffer from a high death rate when young, but once they reach maturity, the members of these very large families not only suffer from no handicap, but they equal or excel all others in longevity.

The explanation of this is fairly obvious. In any collection of records such as the Hyde genealogy furnishes, most of the one and two-child families are those in which one parent was either feeble or died prematurely. It must be remembered that birth control was little practiced in this group (most of the births fall in the first half of the last century). The average family contained five or six children, and when parents had only one or two it was a



ADULT MORTALITY

If child mortality is eliminated, and only those individuals are studied who live to the age of twenty or longer, the small families are still found to be handicapped; but in general it may be said that the larger the family, the longer a member of it will live. (Fig. 7.)

pretty good indication of some constitutional weakness that would make itself felt in the children's heredity.

On the other hand, the mother who bore ten children was certainly of

vigorous stock in most cases. Her children naturally inherited her vigor, and it meant longevity for them. There may have been some disadvantage arising from the large number of offspring, but whatever it was, it was counterbalanced by the very great advantage which comes from the inheritance of vigor, vitality, and a resistant constitution.

INFANT MORTALITY

The higher infant mortality in families of more than ten children reflects the only disadvantage which Dr. Bell's study shows to inhere in large families. The fact that the surviving members of these big families have extraordinary longevity indicates that one's constitution is not permanently impaired by having a dozen brothers and sisters. The high death rate in childhood may be largely due to the fact that the mother has more children than she can properly look after. If this be the correct explanation, then it is evident that whatever disadvantage arises from having even an extreme number of offspring, is not of the kind that results in permanent debility of these offspring. Considering only the factor of heredity, it is evident that there is no danger of racial deterioration from large families: that the families can hardly be too large, under normal conditions. The weak children of a population come not from large families, but from small families.

Of course this does not mean that a small family necessarily connotes weakness of its members. Nor is it intended here to suggest that superior women should bear ten children apiece. It is only desired to point out that, in a normal stock, a child with nine brothers and sisters has, on the average, much more vitality and strength than a child with only one, because it has, on the average, a better heredity.

If superior parents want a large family, they ought not to be discouraged by the widespread but false idea that every child beyond the second or third is likely to be progressively handicapped. If any is handicapped, it is the first-born,[3] but the effect here is not very great. The really important factor in determining a child's vitality is not the number of brothers and sisters who have preceded him, but the kind of stock he comes from. Large families in superior stock will produce superior children; large families in the slums are likely to produce inferior children. In discouraging the latter families, care should be taken not to discourage the former.

EFFECT ON THE MOTHER

The foregoing discussion has been limited to the effect on the offspring of having a large number of brothers and sisters, and it has been shown that the alleged "progressive debility" is a misunderstanding. Nothing has been said about the alleged "progressive decline in the mother's health." That question is too large to be discussed here, but it may be noted that in this case, too, the results depend largely on the kind of inheritance the mother has. Powys' careful study[4] of the admirable vital statistics of New South Wales shows that the longest-lived women are those who have had from six to eight children. A larger family than that apparently is unfavorable to the mother's physique, while a smaller family also goes with diminished vitality. This of course does not mean that a woman of deficient vigor could prolong her life by bearing seven children; it merely means that the women with the greatest inherent vigor tend to bear about that number of children, without suffering any diminution in longevity.

The size of a family must naturally be determined by many considerations besides eugenics. As far as eugenics alone is concerned, relatively large families, in the superior part of the population, are desirable from the point of view of the parents and the children, as well as the race. In eugenically inferior parts of the population, the smaller the family the better for all concerned.

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[3] On the handicapping of the first-born. University of London, Galton Laboratory for National Eugenics, Eugenics Lecture Series X. London, Dulau & Co., 1914. An extended review was given in the JOURNAL OF HEREDITY, vi, pp. 332–336, July, 1915.

[4] Data for the Problem of Evolution in Man. On Fertility, Duration of Life, and Reproductive Selection. By A. O. Powys. Biometrika, iv, pp. 233–286, London, 1905.

HORNED HORSES

Several Well-Authenticated Cases on Record—Not Certain Whether They Are Mere Abnormalities, or Whether They May be Looked on as Reversions to an Ancestral Condition—Manner in Which Horns are Formed

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FROM the Eohippus of the lower eocene formation, with its four toes, and not larger than the house cat;[1] on through millions of years of transition to the Equus or horse of modern times, no animal, perhaps, has shown greater evolution than the horse. It was a long time before paleontologists were able fully to prove the fact that this animal at one time possessed five toes. Will it also be discovered that it possessed horns at one stage of its history?

Herewith is a photograph of a two-year-old filly owned by Dr. J. J. Koger, of Rogersville, Tenn. The filly's sire is of the "Chief" family of Kentucky.

A horn is located on the lower border of the right ear, about 1 inch from the attachment of ear to head. It is firmly attached to the muscles, skin and deep parts of the ear, is moveable, that is, it swings and dangles on movement of the colt's head. It is 3¼ inches long, and a little more than three-eighths of an inch in diameter at base, and has rings and lamination somewhat similar to the horn of sheep and cow. It is of the same color as the hoof and is as hard as the horn of sheep or cow. It sheds one-third of its length every spring about the middle of March.

The filly seems to suffer no more inconvenience from the presence of the horn, than does a lady from the gold-set pearl or pendant in her ear.

The *New York Sporting Times* of March 4, 1905, reports two cases of horned horses, near New York City, owned by A. Day.

Mr. Darwin and other scientists speak of horned horses.

The former says: "In various countries horn-like projections have been observed on the frontal bones of the horse: in one case described by Mr. Percivall they arose about two inches above the orbital processes, and were 'very like those in a calf from five to six months old,' being from one-half to three-quarters of an inch in length. Azara has described two cases in South America in which the projections were between three and four inches in length: other instances have occurred in Spain."[2]

Azara's account is as follows: "I have heard for a fact, that, a short time ago, a horse was born in Santa Fé de la Vera Cruz, which had two horns like a bull, 4 inches long, sharp and erect, growing close to the ears; and that another from Chile was brought to Don John Augustin Videla, a native of Buenos Ayres, with strong horns, 3 inches long. This horse, they tell me, was remarkably gentle; but, when offended, he attacked like a bull. Videla sent the horse to some of his relatives in Mendoza, who gave it to an inhabitant of Cordova, who intended, as it was a stallion, to endeavor to form a race of horned horses. I am not aware of the results, which may probably have been favorable, for the heifers of the hornless bulls are productive, as we shall see further on."[3]

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[1] The Eohippus was figured, from a new restoration by J. W. Gidley, in the April, 1917, issue of this JOURNAL (Vol. viii, p. 168). It had a rudimentary fifth toe, as well as four functional ones.

[2] Darwin, Charles R. The Variation of Animals and Plants under Domestication. New York, 1900, Vol. i, p. 50.

[3] Azara, Felix de. Natural History of the Quadrupeds of Peru. London, 1838, Vol. i, pp. 30–31.

WELL-DEVELOPED HORN ON A MARE'S EAR

This single horn, more than 3 inches long, sheds part of its substance every year, just as the horns of many other animals do. A number of cases have been previously reported, of horses with horns, but the explanation of these growths is something of a mystery. (Fig. 8.)

Percivall[4] wrote: "Some time after joining the Eleventh Dragoons, I was asked by an officer of the regiment whether I had ever seen a horse with horns, belonging to L Troop. This horse had once or twice been the subject of conversation at mess-table, but it struck me to be a hoax, and as such I paid little or no attention to it. A year and a half having elapsed, he was admitted into the hospital stable, with an attack of spasm of the intestines, when the dragoon pointed out the excrescences above alluded to, placed about two inches above the orbital process of each frontal bone, in the center of the forehead, 2 inches apart, projecting from one-half to three-quarters of an inch from the surface of the frontal bones, very much resembling what is felt in young calves five or six months old."

WHAT IS THE EXPLANATION?

Should these horn growths on horses be considered as a reversion to a type, or merely abnormalities? Certainly the evidence is not sufficient to warrant the conclusion that the horse in its descent possessed horns, but it is interesting to speculate on the subject. All the cases reported seem to be mere extensions of the skull, except the present one on the ear. If they are to be classed as freaks, why do they come in twos just as in all horned animals? And why are they so uniformly located? If the other cases were classed as

[4] Percivall, Charles. Horns in the Horse. *Veterinarian*, Vol. i, p. 274, July, 1828.

reversions to a type, this one on the ear might be termed a variation, since in the variation of the rhinoceros' horns, they may be superficially attached. That is, it does occur where the horn has no connection with skull-bone below. Strabo of the first century mentions that horned horses of India were not uncommon. Other early writers reported horned horses. On the other hand, Prof. Matthews of the American Museum of Natural History, states that no specimen they ever found of the ancient horse had any indication of horn cores on the skull. Prof. Matthews' investigations have covered no less than twelve stages in the evolution of the horse, over a period of some three million years.

Horns in cattle, sheep, rhinoceros and others of the higher vertebrates, are composed of two substances, (1) an external shell, the true horn, which takes its origin from the skin, epidermis. Fundamentally it is the same kind of tissue from which the hairs, nails, scales of reptiles and fishes, and feathers of birds are formed. All these widely different structures are in their earliest stages very similar, and are derived from the same primordial cell, the epiblast. (2) An internal core or bone, derived from an entirely different cell, the hypoblast. These cores give support to the external shell. Without such support a horn would be of no service as a weapon of offense or defense. However, feathers, nails, hair, scales on fish are normally without bone support. But scales on sharks and turtles, and some of the fishes, especially geologically old fishes, are usually supported by special bony structures. In short, epidermal structures may or may not be associated with bone and these structures *can* develop without a bone support.

Just what the structure is of the horse's horn, cannot be determined without a cross-section. By this means it could be definitely known with what horn, cow's, or rhinoceros', it is most nearly related. It has all the appearance of being a true horn. Its shape, rate of growth, etc., indicate that it is a real horn. In an early geologic period we find that the horse and rhinoceros took origin from the same stem. If the horse at that time possessed horns, this is a case, perhaps of reversion. I will advance one other theory; as has been mentioned, the hair and horns are derived from the same structure, and this is possibly a modified hair cell, which has been caused by something being knocked out of adjustment accidently, during the horse's embryonic stages. But I know of no instance of horn formation from modified hair follicles, to support this suggestion.

Survey of Musical Ability in Schools

All children in the seventh and eighth grades of the Sioux City schools were recently given psychological tests of musical ability by Dean Carl E. Seashore of the University of Iowa, and his assistants. These exact tests measure the amount of inherent talent which the child possesses, and seventy children were selected, who showed unusual promise and were considered worthy of special encouragement. Of these, twenty-four had never had any training; the rest had had some. It is interesting to note (says *School and Society*, p. 612, 1917) that Dr. Seashore had no information about the previous performance of any of the pupils examined, but the two whom his tests showed to be the most gifted were actually two who have a local reputation as musical prodigies, one of them, a girl of twelve years, being a concert pianist. Dr. Seashore believes that all fifth grade children should be given tests of musical ability, with a view to encouraging those who show talent. His work, which has extended through many years of experimentation, marks an important step forward in vocational guidance and the selection of those who have inborn special abilities, and is to be as widespread as possible.

VARIATION IN ARTICHOKES

Bud Sports Frequent and Offer Promise of Improving Commercial Strains to a Considerable Degree, if They Are Isolated—Methods of Culture

A. D. Shamel

U. S. Department of Agriculture, Riverside, Calif.

IN THE writer's neighborhood of Riverside, California, is a garden of artichokes, *Cynara Scolymus*, Linn., perhaps about one-half acre in extent, grown for the purpose of supplying the local markets with this vegetable. While this artichoke is largely unknown in American households, its popularity in southern California seems to be growing rapidly, so that at the present time it is not only commonly grown in many home gardens, but is also a staple vegetable found on the menus of nearly all of the first-class hotels and restaurants during the late winter and spring months.

The artichoke[1] is a hardy perennial, a native of North Africa and South Europe. Pliny mentions it as a vegetable that was highly esteemed by the Romans. It was introduced into England from Italy about 1548. Its introduction into the United States was probably of comparatively recent date, and, as yet, its cultivation on a commercial scale is largely limited to certain sections of some of the southern and western states including California. Most of the Eastern visitors to southern California, with whom the writer has come in contact, have stated that they had never eaten this vegetable previous to their experience here. Many of them have become very fond of it.

The plant somewhat resembles a large thistle, and, indeed, is often mistaken by visitors for some strange thistle. The stalks and leaves are numerous, large, fleshy, and have a coarse spiny appearance. The leaves are covered with an ash-colored cottony down, are of many peculiar and striking shapes, commonly pinnatifid or pinnatilobed. The flower stems grow erect and attain a height of from four to six feet. The flower heads are usually somewhat globular in shape and consist of imbricated, oval, spiny, broad scales, thickened at the base, of green, or purplish green color, enclosing a mass of flowers in the center. These flower heads in an immature state contain the edible parts, a fleshy receptacle usually called the "bottom," freed from the bristles and seed-down, commonly called the "choke," and the thick lower part of the imbricated scales or leaves.

METHOD OF USE

The common method of using this vegetable here is to boil the immature flower heads until tender. Drawn butter, a sauce, or a salad dressing is provided, frequently a thick mayonnaise. The scales of the flower head are picked off one by one and the base of each is dipped into the sauce and eaten. The "bottom" is then carefully freed from the seed-down or "choke" and is cut up and eaten with the sauce. In France the "bottoms" are often fried in paste and enter largely into ragouts. They are occasionally used for pickling. The flowers are very large and handsome and possess the property of coagulating milk.

The stalks of each plant vary greatly in the time of bringing their flower heads up to the right stage of maturity for cutting. The top flower head of each stalk usually matures first and the lower ones, which are usually of small size, mature later in the season. For this reason the period of production of a field of plants in some seasons covers two or three months, and is frequently from four to six weeks. This

[1] The Treasury of Botany, p. 371.

TWO DISTINCT TYPES OF ARTICHOKE

Typical leaves and flower heads of two strains of artichoke in the Victoria bridge garden at Riverside, Cal. That at the left differs markedly, in both leaves and flower-head, from the one at the right. It is possible that these are both descendants of the same parent plant and that their divergences are to be accounted for by bud variation. Such variation is so frequent, and often breeds so true, that it offers a quick and effective way of improving many important fruits and vegetables. (Fig. 9.)

period at Riverside for the season of 1917 was from about April 1 to about June 15. The number of flower heads produced by each plant varies greatly, some developing only two or three, while others bear twelve or fifteen or more good heads. In some cases the stalks are thinned so that the remaining ones will develop larger and superior heads.

In the artichoke garden near the writer's home there are examples of several strains. The plants of the various strains differ with respect to their habits of growth, number of shoots and leaves, particularly with regard to the shape and arrangement and other characteristics of leaves, number and shape and other characteristics of flower heads, time of maturing the flower heads, and other well-defined characteristics. There are frequent examples of at least three common strains of which two in particular stand

THREE LEAVES FROM A SINGLE PLANT

The wide variation shown in the characteristics of the artichoke is strikingly brought out by the above photograph of three leaves from a plant growing in the Victoria bridge gardens at Riverside, Cal. The fact that plants vary has always been recognized in a theoretical way, but many horticulturists have overlooked the fact that these variations possess great commercial importance. (Fig. 10.)

out as most striking in the preliminary study thus far given these plants.

The plants of one of the strains produce flower heads having a globular shape. The leaves of these plants are usually pinnatilobed. The plants of the other strain bear rather elongated flower heads, making them somewhat cylindrical in shape. The leaves of these plants are usually pinnatifid. Photographs showing the typical flower heads and leaves of the plants of these strains are shown in Fig. 9.

Inasmuch as the plants in this garden have all been propagated asexually, from offsets or suckers, largely from one parent plant, it is but logical to conclude that the variability of the plants is due to bud variation . The suckers were detached from the parent plant in the spring before growth began. The writer hopes to be able to secure some selection of suckers from particular plants with a view to isolating the several strains represented in this field.

The leaf variations shown by some

of the plants are extremely striking. Owing to the large size and fantastic shapes of some of the leaves, this condition, providing easy comparison of leaf forms, is particularly interesting to those concerned with a study of bud variations. In Fig. 10 are shown some of the variable leaves borne by the same plant. Some of the plants in this field apparently present much greater variability than others. In some cases all of the leaves of the plant are comparatively uniform in size and shape while in others the leaves are extremely variable, ranging in shape from a single narrow blade to very finely pinnate forms, and in size from 1 to 4 feet in length. The scales of the flower heads vary in shape, size and color.

SELECTION PROMISES RESULTS

It seems probable that by careful selection of suckers from select plants, strains can be isolated in which the plants will produce a larger number of flower heads than ordinarily with a much larger proportion of edible matter and, as a consequence, be much improved for commercial cultivation.

Owing to the fact that the artichoke is very easily grown, at least under such conditions as those at Riverside, and furnishes a valuable vegetable, it seems that its planting in home gardens should be encouraged. The plants are very ornamental as well as useful and where it is possible to grow them, they constitute a desirable addition to the list of varieties of vegetables. The artichoke is now grown to a very limited extent in gardens on Long Island, in Connecticut and Massachusetts, and can probably be grown successfully in other northern districts providing the crowns are protected during the winter months. If a large planting is planned the rows should be about four feet apart and the plants set about three feet apart in the row. In the beginning it seems best, probably, to start with one, or at most but few plants, which can be purchased from seedmen or growers, then propagate the remainder of the garden from offsets by selecting those which have the fewest spines and whose leaf characteristics are correlated with the production of the largest number of most desirable heads. In this locality the plants may be set out from March to June and during the months of August and September. It seems probable that the plantations should be renewed every three or four years.

This paper is presented for the purpose of calling attention to an opportunity for the improvement of a valuable vegetable variety through bud selection.

The Egg Production of White Leghorns

The egg production of unselected White Leghorns averages about 130 for the first year, 120 for the second, and less than 110 for the third, drops to 85 in the fourth year and falls about 10 eggs a year after this up to the eighth year, according to Bulletin 148 of the Utah Experiment Station. Selected flocks have averaged 160 in America and 190 in Australia. The first-year production of a flock of White Leghorns is no indication of their total production: if it is high, the second year will be low, while if it is low the second will be high. The total production in three years will be about the same. If the first year record of a flock is high, selection of the high layers will materially improve the later production of the flock. If the record of the pullet year is low, there will be little value in selection, as even the lowest producer will make a second-year record above the general average. The average life of a White Leghorn appears to be about six years. The average production of the fourth year (eighty-five eggs) is equal to the average production given for hens of all ages in the United States. The average total production of a White Leghorn hen, during her entire life, is above 500 eggs, and may rise as high as 1,000.

REMARKABLE BUTTONBALLS

R. W. SHUFELDT, *Washington, D. C.*

IN THE March, 1917, issue of *American Forestry* (p. 146), I invited attention to the fact that the familiar globular flower-balls of the Sycamore or Buttonwood tree, ordinarily borne singly, are sometimes in pairs, the peduncle of the lower ball apparently being pressed into the side of the ball above, leaving a depression in the lines of the peduncles. An example of this condition, collected at Washington, D. C., was given by a photograph which I had made.

The description would lead one to believe that the condition was a rare one, and such was my impression at the time of writing the article, especially when I found, in the last edition of Gray's "New Manual of Botany" (1908), that not only was there no allusion to this condition, but on the contrary it is stated, in the description of these flower-heads: "fertile heads, solitary, hanging on a long peduncle" (p. 454).

Since publishing the above exception, I have examined a large number of trees in and about Washington, and I find that the condition is not nearly so unusual as I first supposed. The publication of the fact, however, has evidently been responsible for inducing a great many other people, in all parts of the country, to look into the matter, and not a few letters have been written to me on the subject.

The *single* ball or flower-head is undoubtedly the normal condition; and it would be interesting to have any light thrown on the origin of the multiple ones, or if the latter ever occur on *typical* wild trees. Henry W. Scattergood, of Philadelphia, writes in regard to this tree: "I have a large specimen on the lawn of my home in Germantown, and on looking over the button balls lying on the ground, I found a number of the double variety which you describe as abnormal, also triple ones. There are a number of both still on the tree. . . . Am also mailing a couple of the double and one triple specimen under separate cover." In the triple specimen I found the peduncles to the balls all in line, as in my figure given in *American Forestry*. Personally, I have never seen the triple balls in nature or on other trees, and I was about to photograph the specimen, when Charles E. Mather, of Philadelphia, invited my attention to the fact (April 1, 1917) that they also occurred on the sycamores on his "Meadow Farm" at Brandywine. This correspondent topped the record by proving that the cluster sometimes contained as many as *four* balls, with the four peduncles all in line. Mr. Mather has some twenty sycamores on his place, all of which he carefully examined with the result of finding only this single example of four balls strung together. He states positively that "the native trees only have one ball." He sent me the four-ball specimen; and, while it had been somewhat damaged in the mails—the balls being about to go to pieces—I made a photograph of it; this is here reproduced to illustrate the condition. The superior half of the lowermost ball had become detached and broken up.

Mr. Mather has been so good as to make photographs of two of his sycamore trees, showing examples of three balls in a cluster or string, and these pictures I have in my possession. The Morris Nursery Co., of West Chester, Pa., under date of April 2, 1917, wrote Mr. Mather to the effect that "we sent you some years back the Oriental Buttonwood, the only kind we grow, as it is superior to the American Buttonwood."

This latter occurs, according to the botanies, pretty generally throughout the eastern half of the United States, but not west of eastern Kansas, while the range and habitat of the Oriental Buttonwood or Sycamore is still unknown to me. From the wide interest taken in the matter, it would appear to be worthy of further investigation, especially along the line of specific variation, not only of the flowers but of the trees as well.

A SYCAMORE "FOUR-IN-HAND"

Ordinarily the flower heads of the oriental sycamore (*Platanus orientalis*), a shade tree widely grown in the United States, occur singly. But sometimes two, three, or even four are joined together, in which cases the stems are in line with each other. Photograph by Dr. R. W. Shufeldt. (Fig. 11.)

WHY THE CABBAGE BUTTERFLY DOES NOT INCREASE MORE RAPIDLY

The most destructive of the many enemies of the cabbage and related crops in the United States is the cabba
fly (*Pontia rapae*) which is shown above in the act of laying an egg on a cabbage leaf. The green worm which ha
this egg is shown in the second photograph; sometimes it is not discovered until the cabbage reaches the dinner

1883 an ichneumon fly (*Apanteles glomeratus*) was imported from Europe to keep the cabbage worm in check. It lays its eggs in the body of the cabbage worm; the larvae which hatch from these eggs make a meal on the worm and then cut their way out and spin yellow cocoons beside his dead body. The number of cocoons shown in the photograph illustrates what a small chance the cabbage worm has of surviving this parasite. It is interesting to note that the parasite is in turn preyed upon by a superparasite, a little chalcis fly: "and so on down, ad infinitum," no doubt. If a cabbage grower finds cocoons of the ichneumon fly, he should put them in a box and put with them all the cabbage worms he can collect. He will thus aid the parasite to propagate, and get a good stock established in his garden. Copyrighted photographs by Brown and Dawson. (Figs. 12 and 13.)

BULL TERRIER BREEDING

Ancestry of the Breed is a Cross between White Bulldog and Black-and-Tan Terrier—Modern Standards Are Peculiar and Exacting—An Interesting Case of Intensified Line-Breeding

Robert Duncan Coombs

Longmeadow Farm, Ridgewood, New Jersey

IN THE early part of the nineteenth century the name of terrier was applied indiscriminately to a number of breeds, as well as to a number of crosses and mixed breeds. The bull terrier of that period had a combined ancestry of bulldog and black-and-tan terrier. The current type of pit-bull or fighting terrier would seem to bear a closer resemblance to the Victorian-era bull terrier than does the modern bull terrier. This is due to the fact that careful breeding has established the standard bull terrier breed as an all-white short-haired dog fairly regular both in bodily type and mental characteristics.

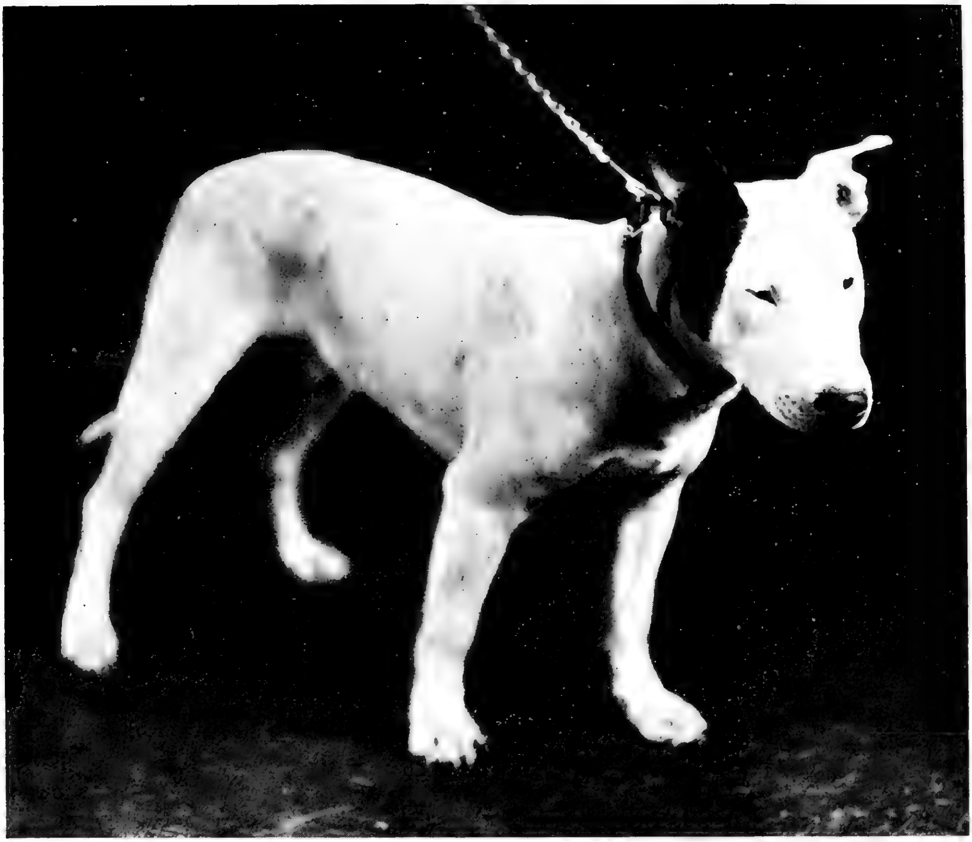
It is unfortunate that the terrier used for fighting has been so frequently confused in the popular mind with the bull terrier. This misconception is so general that almost any short-haired, white, strongly built dog, which resembles the breed, will be called a bull terrier, however mixed its ancestry may have been and however bad its disposition. As a matter of fact the breeding of the better class bull terriers shows a pure ancestry for very many generations, as is proved by the standard all-white color.

The "standard of the breed" calls for a dog of rather definite characteristics and of a type readily distinguishable from other breeds. Without exaggeration of any feature the animal should combine strength and agility. The head should be long, with the fore-face filled up to the eyes, the muzzle wide, yet tapering; under jaw strong, lips tight and teeth meeting evenly. An overshot or undershot jaw is a bad fault, as is "lippiness." Neck medium and shoulders muscular but without distortion or heaviness. Shoulder blades wide, flat, and sloping well back. The ribs should be well sprung and the chest deep and wide. The legs big-boned with straight but not stilted forelegs. Feet "cat footed" and straight toed, tail straight, tapering, medium length and not carried above the level of the back. Coat dense, short, stiff and glossy. The color of the hair and skin *white* except that the nose and eyes should be *black*. Eyes "triangular" (sic), small, set close together and obliquely.

"OLD DUTCH"

He is one of the pillars of the Bull Terrier stud book, although his legs were "all wrong." His claim to greatness rested largely on the shape of his head, which was much admired by connoisseurs. After Watson, The Dog Book. (Fig. 14.)

From the above description it will at once appear that the typical bull terrier possesses very marked characteristics. It will also be noticed



MICHAEL, A "MARKED" DOG AND SHORT IN FRONT LEGS

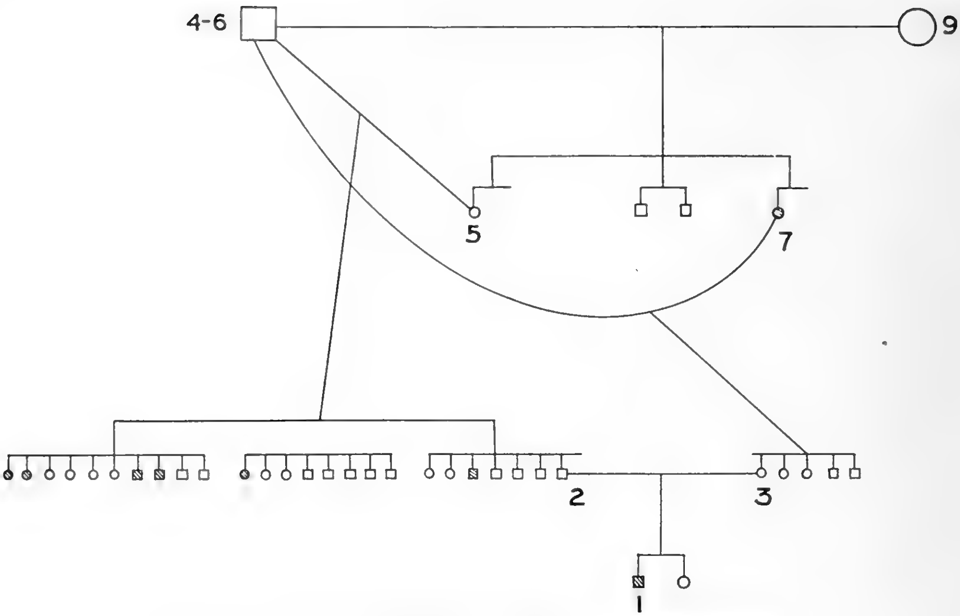
The standard of the breed calls for a white animal with pigment in only two places—eyes and nose. But many dogs carry a diluted pattern in the coat—the faint spots can be seen on the back—and many of them in addition show an outcropping of color on the head, Michael's "mark" being on and around the ear. This does not disqualify a bull terrier, but is considered a defect. The colors of the mark are black and tan, indicating that the breed was originally a tricolor one (black, white and tan) and has been steadily selected for whiteness. As a fact, it originated in a combination of white bulldog or "mastiff" (sic) and black-and-tan terrier. (Fig. 15.)

that the standard requires what may be termed a special albinism, in that there should be no pigmentation except in two places, the eyes and nose, and that pigmentation should be as nearly jet black as possible. The breed is an old one and cross breeding has been rather rare since it is heavily penalized by "faults" in the offspring.

Color spots when they do appear are often about the head and may be black, black with tan edge, or tan. In addition to the above "marks" or colored hair, there are often so-called "skin spots" which are hidden by the outer coat, and are then disregarded.

A "mark" is not a disqualification in the show ring as indicated by the marked dogs that have become champions. It is, however, generally undesirable.[1]

[1] A spotted pattern, similar to that on the dogs, is found in a great many mammals. By selection it can gradually be reduced, in which case it disappears first from the body and last of all from the head (head and ears in mice; eyes, ears, and nose in guinea-pigs; eyes in rats; ears in cattle; head in rabbit). It can never be controlled absolutely, however, because it is apparently due very largely to developmental differences, as well as to inherited factors. Hence there is no



AN ILLUSTRATION OF INTENSIVE LINEBREEDING

Above is a skeleton pedigree of the bull-terrier Michael, who figures as No. 1, at the bottom of the chart. It will be noted that he has but one grandsire, instead of two, and one great-grandsire, instead of four. Squares represent males and circles females, while the shaded symbols designate "marked" dogs. (Fig. 16.)

On the other hand the continued linebreeding of dogs which rarely or never reproduce spots may result in a too complete albinism. This would produce blue eyes or parti-colored noses—worse faults than the "mark."

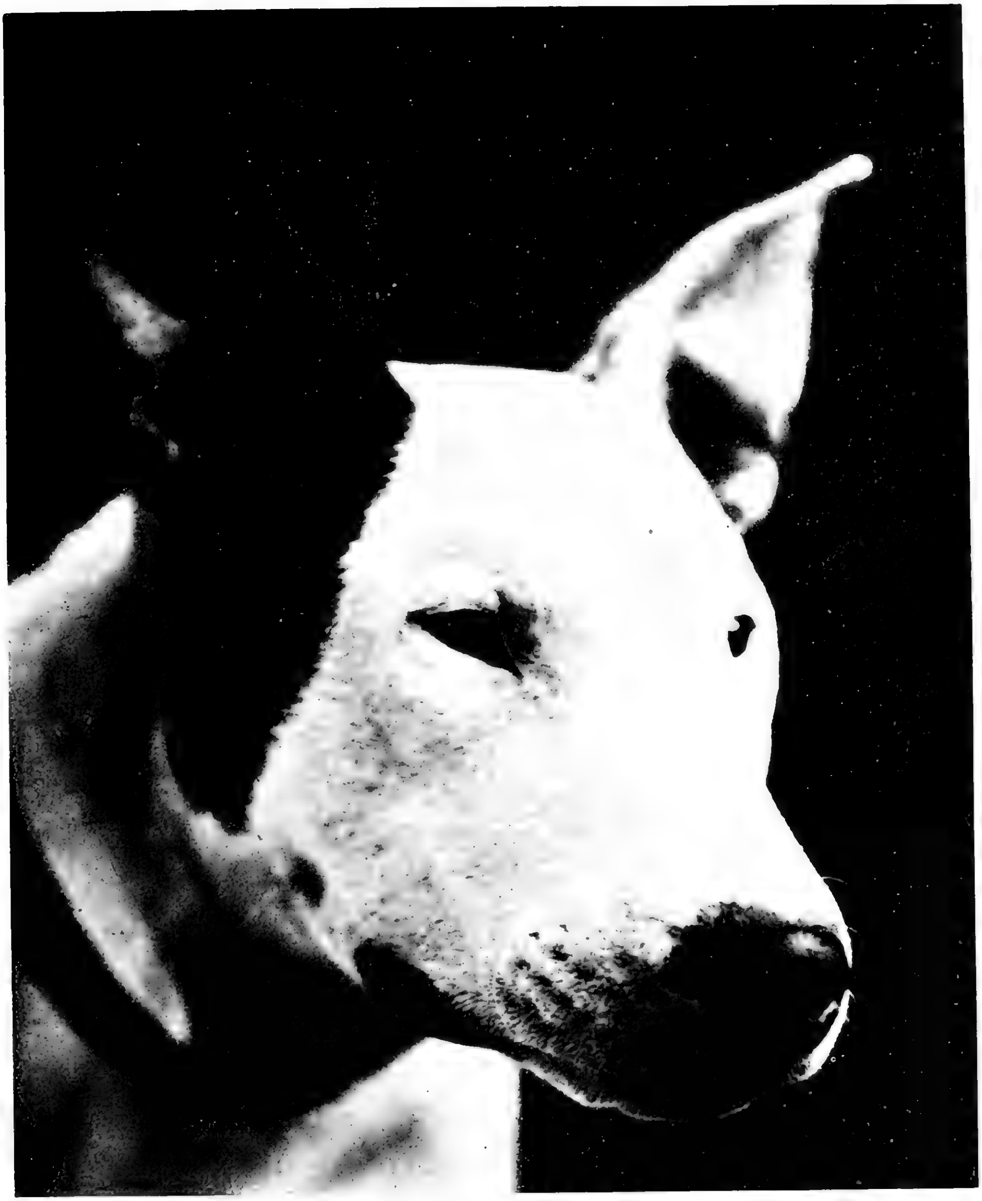
The pedigree, Table 1, shows ten generations from Longmeadow Michael, whelped in 1916, to the pillars of the stud book, Old Dutch (1878), Champion Maggie May (1879), etc. With one or two exceptions all these dogs were registered either in England or America and their records are in the official stud books of the two countries. A gap exists back of Tonkinson's Sam and Malins' Rose which is presumably due to carelessness in entry or in ownership. It may be justly assumed, however, that both were of good stock in view of the success, in the show ring, of their descendants. Further, it is more than probable that the ancestors of these two dogs are to be found elsewhere in the table.

Tables 1 and 2 show the frequent interbreeding that occurred and, so far as it is now possible to ascertain, which dogs were "marked." There were unquestionably other marked dogs in many of these old litters but the marking of actual ancestors is believed to be fairly accurate.

Apart from the perpetuation of the standard coloration there was a general excellence in form as shown by the number of champions recorded and by the fact that most of the others did some winning in the show ring.

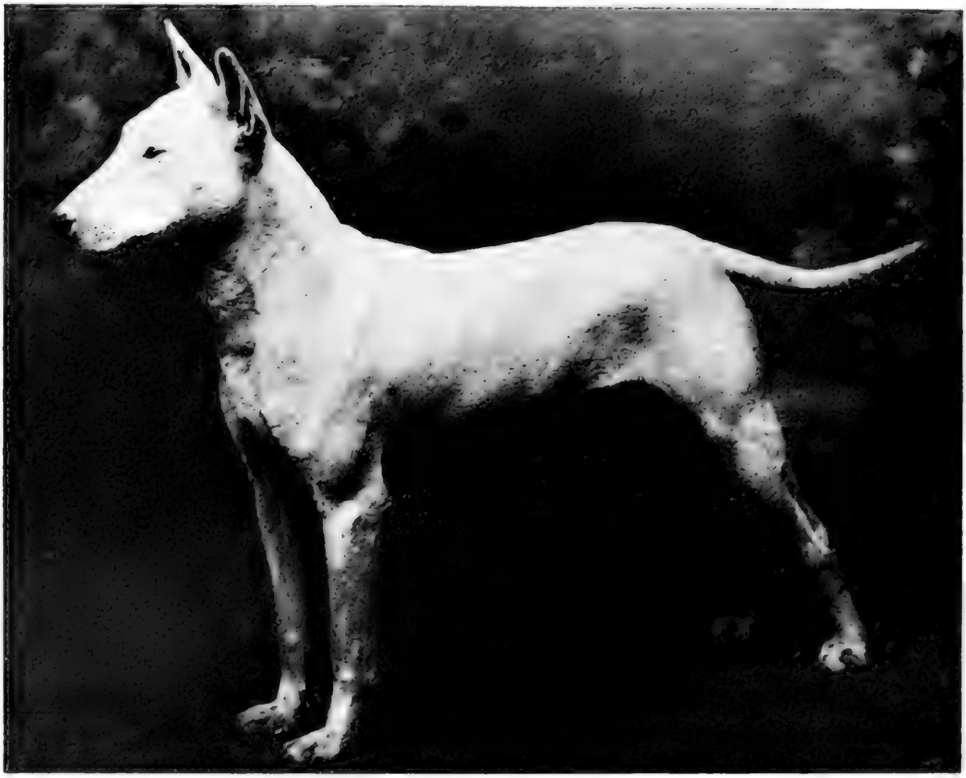
Provided the bodily form was good, and particularly if the difficult head was good, there seems to have been little hesitation in breeding to a marked

hope of establishing a strain of bull terriers which will produce no "marked" dogs: the breeder must be prepared to find in every litter some fluctuation in the amount of pigment. If the average dog has just the right amount—*i. e.*, black eyes and nose—there are sure to be others constantly appearing who will have too much—*i. e.*, marks—or too little—*i. e.*, blue eyes and white nose.—THE EDITOR.



HEAD OF LONGMEADOW MICHAEL

It should be compared with that of Old Dutch (Fig. 14), who is one of the principal ancestors of the modern breed. The standard of the breed calls for a long head with foreface filled up to the eyes, the muzzle wide yet tapering. Under jaw must be strong but not exaggerated as is that of the bulldog: the lips must be tight and the teeth meet evenly. The bull terrier's ancestry is a combination of bulldog and black-and-tan terrier; it is evident that the typical bulldog face has been largely bred out, in spite of its pronounced peculiarities. (Fig. 17.)



A GOOD TYPE OF THE MODERN BULL TERRIER

In the mind of the public, much confusion exists as to what a bull terrier is, and the name is often applied to anything that looks like a bulldog. The breed is really very well defined and established, and has lost all of the characteristic bulldog appearance and temperament. The imported champion "The Outwood Hope," shown above, is a good example of the real bull terrier of the present day. (Fig. 18.)

dog. Thus Gully the Great, a marked dog, appears thirty times in the pedigree, while Old Dutch appears twelve times although "all wrong" in legs. The latter's claim to greatness rests on his head formation which, as shown by Fig. 14, made him a desirable stud.

The writer practiced intensified line breeding on Michael who has but one grand-sire and one great-grandsire. Neither of his parents was marked although one grand-dam was marked (on the head) and his grandsire has averaged perhaps one marked dog in every ten. On the other hand the great-grand-dam Champion Iris tended to be deficient in pigmentation. Michael as shown by Fig. 15, is marked black and tan on one ear and the coat under the ear.

This litter resulted from the first breeding of the dam, to her half brother. The fact that there were but two puppies and one was marked does not in the writer's opinion, in itself, possess any definite significance. Both puppies were strong and healthy. Michael will be a heavy weight, probably 50 pounds, while Susie will resemble her dam and remain in the neighborhood of 35 pounds.

The standard permits two distinct sizes, *i. e.*, "less than 35 pounds" weight and about 17 inches high, and "over 35 pounds" and about 20 inches high. Both sizes may occur in the same litter, the leg bones of the heavy-weights being noticeably heavier even in puppies.

	Michael	*Sister Susie*
Weight at birth...	10 ounces	10 ounces
Weight 1 week...	18½ ounces	18 ounces
Weight 3 weeks...	5¾ pounds	4¾ pounds
Weight 6 weeks...	7½ pounds	6¼ pounds
Weight 4 months.	19 pounds	16½ pounds

Considering that part of the family following Patrician and Iris, both of whom were champions, all white, and over 35 lbs., the former having a general record of approximately one marked dog per litter and the latter having a tendency to under pigmentation, we have Fig. 16 to which the following description applies.

First Generation

(Michael)	Male	Fair	Heavy	Marked
(Susie)	Female	Fair	Light	

Second Generation

Female	Very good	Marked
Female		Marked
Female		
Female	Good	
Female		
Female		
Male		Marked
Male		Marked
Male		Parti-color nose
Male	Good	

Female	Good	Marked
Female	Good	
Female	Good	
Male		Parti-color nose
Male		
Male	Good	
Male	Good	
Male	Good	

Female	Good	
Female		
Male	Deaf	Marked
Male		
Male	Very good	
Male	Very good	
Male	Very good	

Female	Good
Female	
Female	
Male	Good
Male	

Third Generation

Female	Good	
	Rest of litter unknown	

Male		
Male		
	Rest unknown	

Female	Good	Marked
	Rest unknown	

In conclusion the writer offers this collection of data as a contribution toward what he believes would be an interesting study, *i. e.*, the genealogical tendencies of the Bull Terrier, a breed requiring extremely marked and somewhat antagonistic characteristics.

TABLE 1.—*Tabular Pedigree—Ten Generations*

Dogs	*Appearances*
Gully the Great	30
Old Prince	18
Tonkinson's Sam	18
Malins Rose	18
Gladstone	14
Florrie	14
Woodcote Wonder	14
Dulverton	14
Bromige's Fan	14
Maggie May	12
Kit	12
Old Dutch	12
Vincent Monarch	12
Rookery Boy	12
Amazement	12
Rose of Kent	12
Wallace	10
Baron	10
Old Victor	10
Old Duke of Marlborough	10
9 dogs each	8
22 dogs each	6
77 dogs each	4
114 dogs each	2
4 dogs each	1
245	1,022

TABLE 2.—*"Marked Dogs"—Ancestral Positions Indicated by Galton's System of Numbering*

(*a*) 146–182–210–246–286–290–306–338–356 414–418–434–466–484–544–564–598–618 670–674–690–752–820–854–874–800–926 930–946–1008.
(*b*) 740–742–996–998
(*c*) 741–997
(*d*) 34–50–82–114
(*e*) 7

Men and Rats Learn in the Same Way

An attempt to compare human and animal learning has been made by L. A. Pechstein (Psychol. Monogs., No. 2, 1917). He has taken the results of tests made on men and on rats recently by experimental psychologists and compared them by statistical methods. His conclusion is that "there is no royal road to mastery for the human not open to the rat."

A HIT-OR-MISS UNIVERSE

The Mechanistic View of Life, as Expounded by Jacques Loeb—Possibility That Life Is Eternal, and Never Had a Beginning—No Evidence of any Intelligent Guidance of Evolution

A MAN who lives far from architects and builders can put up a very good house or barn nowadays by buying it "K. D." The entire structure will be shipped to him "knocked down;" every part will be cut to fit, and numbered, and he has only to follow the plan which is sent him, to get each piece where it belongs and produce a finished building.

Evidently, the plan or design is essential. If the "K. D." building were picked up in the railway yards by a cyclone, carried ten miles and then dropped beside a road, its parts would hardly be expected to arrange themselves in the proper order, nail themselves together, and produce a finished building of their own accord. The building is possible only when each separate part is in its proper place with respect to the others—a fact which seems to make a plan a prerequisite.

The development of an animal from a fertilized egg has been looked on as analogous in some ways to the construction of a house. Students of genetics have established the fact that the parts of the adult are in some cases represented in the egg by factors which are distinct and separate. The tiger's stripes and his temper are, it is alleged, each represented by something in the original cell—a chemical reaction, probably, which, after a long series of reactions and interactions in the cell and in the developing embryo, ends up by producing the stripes, or the temper, as the case may be, in the tiger cub.

How do these things develop in the right order? Is it possible to conceive of such a complicated process, unless one conceives of some pre-existent design or plan in accordance with which the process of development is carried out? It might be admitted that the plant or animal is a machine; it might even be supposed that it is a machine which automatically runs itself; but can the human mind go so far as to believe that it is also a machine that manufactures itself?

Darwinism suggested this conclusion, but did not establish it. It can only be established through experimental biology.

IT WAS AN ACCIDENT

In his latest book,[1] Jacques Loeb attempts to show that a purely mechanical view of development is consistent with the facts. His explanation is (to carry the analogy a little farther) that if the cyclone picks up not one but ten thousand "K. D." houses, 9,999 of them might fall as mere heaps of kindling and nails, but that one of the number might by chance be dropped in a recognizable shape.

In addition to this, Dr. Loeb's book is a well-written brief for the mechanistic view of life in all branches of investigation. It is worth reading because, whether or not one likes a purely mechanical *philosophy*, a mechanistic *working hypothesis* is being recognized by more men of science each year as the most profitable for research. If the hypothesis used is a loose one, the investigator will never know whether his facts fit it or not. But if the hypothesis is as rigid as can be imagined, then any unconformable fact will at once be recognized as such, and the hypothesis can be enlarged to take it in.

The attempt of experimental biologists to reduce all the manifestations of life to terms of physics and chemistry

[1] The Organism as a Whole, from a physicochemical viewpoint. By Jacques Loeb, M.D., Ph.D., Sc.D., member of the Rockefeller Institute for Medical Research, New York City. Pp. 379, with 51 illustrations, price $2.50. New York, G. P. Putnam's Sons, 2 West Forty-fifth Street, 1916.

is, therefore, well worth while; but they face some formidable difficulties. Can they eliminate from heredity and development all plan and design, all "vital principle," all guidance of an intelligence? Can they reduce the immensely complicated life processes to reactions that are, in principle, as non-mystical as the evaporation of a drop of water in the sunshine, or the rising of a batch of dough which contains baking powder? In short, can all actions of so-called living matter be referred to those well-known properties which characterize so-called dead matter? Is there no essential difference between the world of living things and the world of winds, rocks and waters?

Of course, much more knowledge must be gained before any of the questions involved can be answered with confidence. Dr. Loeb attempts only to pick out a few typical problems and to show that these can be explained on a purely mechanical basis. If the mechanistic explanation proves adequate in one place, he argues, is it not right to suppose that it may not also hold good in other places? Even with this limited scope, his argument is frequently open to the criticism of passing by difficulties that to the reader may seem fatal. However, the object of this review is not to criticise his statement of the case, but merely to give a summary of that statement.

THE NATURE OF LIFE

1. First of all, is there any essential difference between living matter and dead matter? Life and death are daily accepted as antithetical, and it is generally supposed that there is some mystical quality inherent in life, which distinguishes it from the primal elements that admittedly enter into its makeup—from carbon, hydrogen, oxygen, iron, lime, and so on. Inquiry into the possible origin of life may clear up this point.

At present the perpetuation of living matter depends primarily on sugar, without which life ordinarily cannot exist. Sugar is not found in minerals, but is manufactured by plants, by the help of the red rays of sunlight, from the carbon dioxide of the air. But if the first life came from sugar, where did the sugar come from? This difficulty was surmounted a few years ago when it was discovered that some bacteria live exclusively on minerals, and can produce sugar directly from these minerals. It is no longer impossible, therefore, to conceive of organisms which could have existed on this planet at a time when it contained only minerals, no living matter; and which could from these minerals have manufactured the sugar which was necessary for the manufacture of proteins and the evolution of higher forms of life.

The first life in this world was possibly a plant similar to the modern blue-green algae. Experiments have failed to show that spontaneous generation can occur; the modern belief is that life comes only from life. It is then not safe to assume that this primordial, one-celled plant sprang into existence on the cooling globe, merely by chance, and Dr. Loeb inclines to believe that it was carried here from some other planet. "May not life after all be eternal?" he asks. If so, it is merely necessary to assume that it is passed on occasionally from one planet to another. It cannot come with meteorites, for they are too hot; but Arrhenius has suggested another means of transmission, based on the fact that for particles below a certain size the mechanical pressure produced by light waves can overcome the attractive force of gravitation.

Bodies which according to Schwarzschild would undergo the strongest influence of solar radiation must have a diameter of 0.00016 mm., supposing them to be spherical. The first question is, therefore: Are there any living seeds of such extraordinary minuteness? The reply of the botanist is that spores of many bacteria have a size of 0.0003 or 0.0002 mm., and there are no doubt much smaller germs which microscopes fail to disclose.

"We will, in the first instance, make a rough calculation of what would happen if such an organism were detached from the earth and pushed out into space by the radiation pressure of our sun. The organism would first of all have to cross the orbit of Mars, then

the orbits of the smaller and the outer planets. . . . The organism would cross the orbit of Mars after twenty days, the Jupiter orbit after eighty days, and the orbit of Neptune after fourteen months. Our nearest solar system would be reached in 9,000 years."

LIFE FROM OTHER WORLDS

There would, therefore, be no difficulty of time about transferring life from one planet of our system to another, for almost any germ could live that long. But if life is to be considered eternal, it must be capable of transmission from one solar system to another, and the shortest trip to ours is, as noted, 9,000 years. Could any known organism survive so long? Arrhenius thinks it could because of the low temperature (below—200° C.) of the space through which it would travel, where no chemical reaction could take place, and hence no decomposition or deterioration in the spores; and because of the absence of water vapor. There is even experimental evidence to support this. Bacteria were exposed for six months to liquid air, at a temperature of about —190° C. and their vitality did not seem to be affected in any way. In the cosmic space the temperature is lower than this, there is no atmosphere or water vapor and, says Dr. Loeb, "there is hence no reason why spores should lose appreciably more of their germinating power in 10,000 years than in six months. We must, therefore, admit the possibility that spores may move for an almost infinite length of time through cosmic space and yet be ready for germination when they fall upon a planet in which all the conditions for germination and development exist, *e. g.*, water, proper temperature, and the right nutritive substances dissolved in the water (inclusive of free oxygen)."

It is thus possible to imagine that living matter never had a beginning, any more than matter in general. If so, it would be idle to try to create life in the laboratory. But it is still necessary to inquire more closely, how living matter differs from dead matter. How does the growth of a germ differ from the growth of a crystal? The essential difference is that the crystal simply adds to itself by taking up material like itself, while the living cell adds to itself by building up compounds, specific for each organism, from the dilute, split products of these compounds. The one process is probably just as much explicable in chemical terms as the other. While the life process is vastly more complicated, and also differs in kind from such a simple chemical process as the manufacture of rock candy, yet it is not necessary, in Dr. Loeb's view, to regard the latter as wholly natural and the former as partly supernatural.

WHAT IS A SPECIES?

2. The second point in which Dr. Loeb attempts to substitute a simple mechanical idea for a mystical one, is in the explanation of the basis of a species. Under the microscope, the protoplasm from the cell which will produce a whale, can not be told from the protoplasm which would produce a hummingbird. Yet whale eggs always give rise to whales, and hummingbird eggs to hummingbirds. Furthermore, a species may remain constant for a long time. Walcott has found fossils of annelids, snails, crustaceans and algae in precambrian rocks in British Columbia, whose age may be as great as 200,000,000 years; yet these are so closely related to forms existing today that scientists have no difficulty in finding the genus among modern forms to which each of the fossils belongs. Wheeler has studied ants preserved in amber for 2,000,000 years, which belong to species that are still living. And the constancy of the sea invertebrate, Lingula, for at least 100,000,000 years, was recently illustrated in this Journal.[2] Moreover, the geneticist knows that species which are widely different from each other cannot be hybridized. They are "incompatible." What is it that underlies this specificity?

[2] "The Oldest Known Animal." JOURNAL OF HEREDITY, VIII, p. 146, April, 1917.

It has been found to be due to the fact that each species possesses proteins which differ from those of every other species; but at the same time it possesses also a genus-protein, which is shared by other species of the same genus, but differs from that of all other genera. The heredity of genus and species may be safely considered as due to the transmission of distinctive proteins; and there is some reason to think that these proteins are not carried in the chromosomes, or even in the nucleus of the germ cell. They may rather be located in the cytoplasm of the egg-cell. In any case, the specificity of life is found to be due to definite chemical causes, and not to anything mystical.

3. Fertilization of the egg and the commencement of its development are treated at some length, but the details are too technical to be summarized readily. Dr. Loeb's general conclusion is that there is nothing about these processes which need be considered outside the sphere of scientific knowledge.

PARTHENOGENESIS

The experiments on artificial parthenogenesis, which have mainly established Dr. Loeb's prestige in the eyes of the layman, are reviewed in this connection. Fertilization of the egg had been considered to consist of the union of two nuclei; but when it was shown that development could equally well be started by chemical solutions, by sticking a needle into an egg, or by injecting blood into it, biologists were forced to abandon the idea that the union of the two nuclei was the essential part. It was easy to understand that the primary function of the male cell was to furnish a stimulus—a very simple one, obviously, if the successful substitutes are considered.

Artificial parthenogenesis has been successful not only with numerous invertebrates, but with animals as high in the scale as a frog; and with at least one plant. Dr. Loeb thinks there is no inherent impossibility about such development in the warm blooded animals as well. The objection that eggs thus stimulated could not be made to develop beyond the earlier stages, has now been remedied by improved technique; Delage brought a sea urchin to maturity by artificial parthenogenesis,

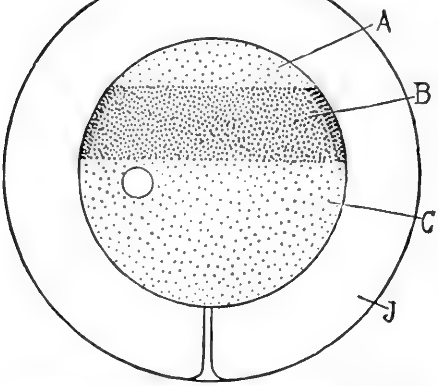
A FATHERLESS FROG

This frog was raised by Dr. Loeb from an egg-cell which had been "fertilized" merely by jabbing it with a fine needle. It is shown actual size. According to Dr. Loeb, it was no different from ordinary frogs which result from the union of two germ-cells. The spermatozoön can be entirely dispensed with in this way, but the egg-cell cannot; hence it appears to Dr. Loeb that the egg-cell produces the embryo in the rough, and that the sperm-cell adds only more or less superficial characters. (Fig. 19.)

and Loeb himself has very recently succeeded in bringing a fatherless frog to full size. The frogs, which result from the union of an egg-cell and a fine needle, can in no way be distinguished from frogs produced in the natural way by the union of an egg-cell and a sperm-cell. But while the egg-cell can thus be made to develop into an adult, without uniting with a sperm-cell, it has in no case been possible to produce development of a sperm-cell without union with an egg-cell.

From these facts two conclusions stand out prominently: (*a*) that the fundamental effect of the sperm-cell is

merely to give a stimulus to the egg-cell and cause the development of the latter; and (*b*) that the species-heredity must be carried by the egg, the sperm furnishing only Mendelian or relatively superficial inherited characters, which can be wholly dispensed with.



GROUND-PLAN OF AN EGG-CELL

It was formerly thought that the embryo was built up out of formless material in the fertilized egg-cell; and this development seemed to call for supernatural guidance. But it has now been found that even before the egg-cell is fertilized, it contains the embryo "in the rough;" and the process of development merely adds the details to the design that is already blocked out. This view makes development seem a much simpler and less mysterious process. The above diagram of a sea-urchin's egg (after Loeb) shows within the cell-wall (*J*) three well-defined zones: (*A*), a small, clear cap at one pole; (*B*), a pigmented ring; and (*C*) another unpigmented area. It has been found that each of these areas gives rise to a definite part of the embryo, as explained in the text. (Fig. 20.)

SPECIES-HEREDITY

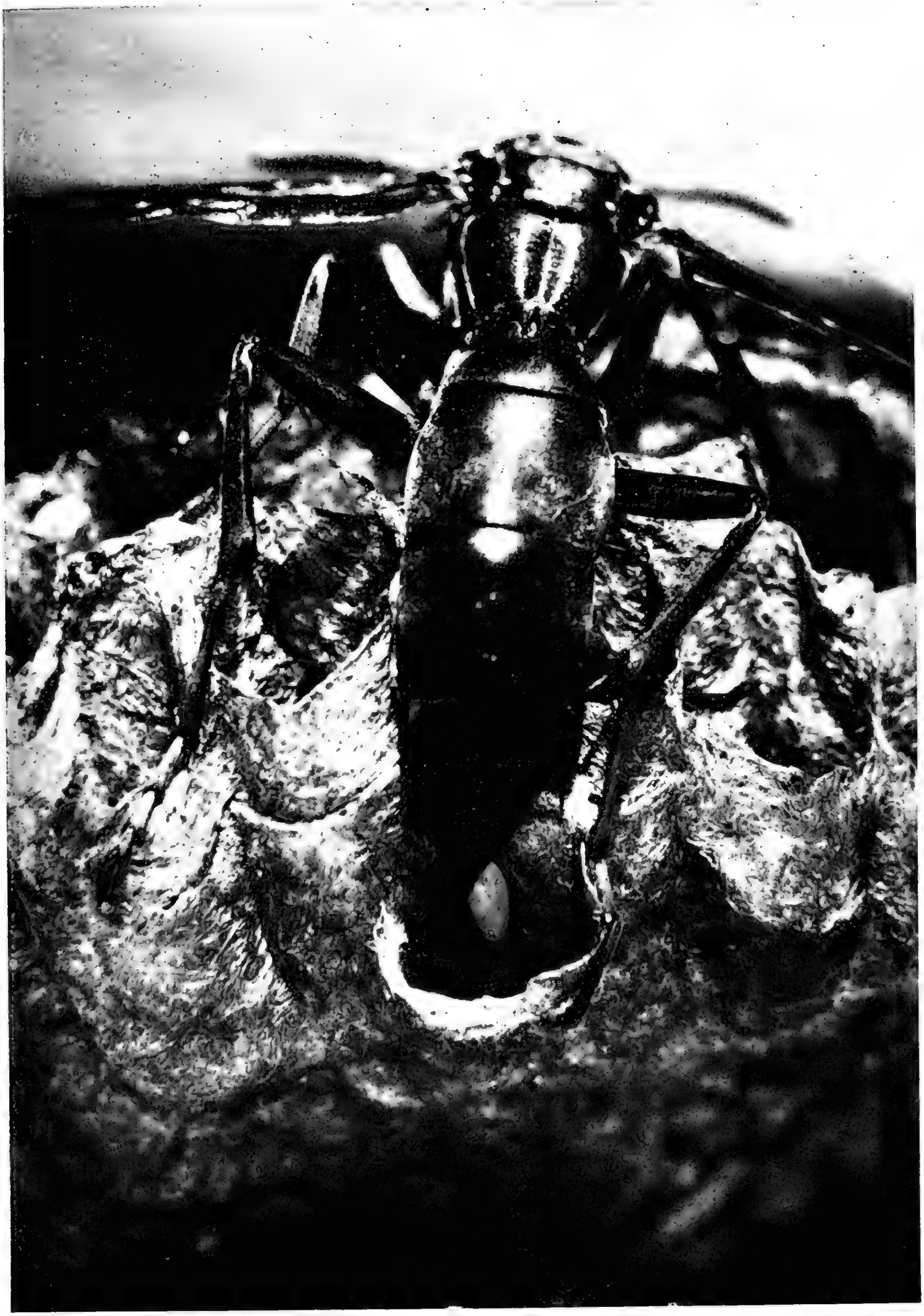
4. This opens up an aspect of heredity with which genetics is unable to deal. Study which proceeds from experimental breeding and hybridization, as genetics does, can only deal with differences in animals or plants that can be crossed; it cannot grapple with the greater problem of why one fertilized cell develops into a horse and another that is apparently not very unlike it develops into a lobster or an elm-tree. Genetics has to infer what goes on in the cell, by its observation of the characters of the *adult* organism; and, as Darbishire remarked, this is like trying to infer the nature of the works of a clock by watching the movement of its hands. Hence the embryologists have, during recent years, been able to make a contribution of fundamental importance to the study of heredity.

The most important part of it is the demonstration that the plan or design for the adult organism is laid down in the egg, even before it is fertilized. Hence there is no longer need to marvel at the intelligence with which the various factors of the egg and sperm coöperate to develop harmoniously into the adult. There is no longer need to imagine any purposive or mystical guidance of the process of development. The egg *starts* with a structure outlined in it, and development is merely a process of growth at varying rates, which develops each part of the structure in the proper way.

The existence of this structure in the unfertilized egg was discovered by the late Th. Boveri while studying sea-urchins. There is some yellowish-red pigment in the egg, and he noted that this is not equally distributed over the whole surface of the egg, but is arranged in a wide ring from the equator almost to one of the poles, as shown in Fig. 20. Thus three zones can be recognized: in the upper one, the skeleton and connective tissue originate; in the middle (pigmented) one, the intestine is built up by simple cell-division; while the third zone gives rise to the outer body-wall. Conklin has found similar structure in the unfertilized eggs of many other low animals.

FUNCTION OF THE SPERM

"The most important fact which we gather from these data is that the cytoplasm of the unfertilized egg may be considered as the embryo in the rough and that the nucleus has apparently nothing to do with this predetermination. This must raise the question suggested already in the third chapter whether it might not be possible that the cytoplasm of the eggs is the carrier of the genus or even species-heredity,



WASP LAYING AN EGG

The common paper wasp (Polistes) builds its comb under the eaves of buildings, and is a familiar object in most parts of the United States. The nest is started in the spring by a single female, who was fertilized in the preceding autumn, and lived through the winter in some sheltered crack. After she has built a few cells of paper she has made by chewing up old wood, she lays eggs in them from which functionless females or neuters hatch out. Photograph by Brown and Dawson. (Fig. 21.)

while the Mendelian heredity which is determined by the nucleus adds only the finer details to the rough block. Such a possibility exists, and if it should turn out to be true we should come to the conclusion that the unity of the organism is not due to the putting together of a number of independent Mendelian characters according to a 'pre-established plan,' but to the fact that the organism in the rough existed already in the cytoplasm of the egg before the egg was fertilized. The influence of the hereditary Mendelian factors or genes consisted only in impressing the numerous details upon the rough block and in thus determining its variety and individuality."[3]

Primitive biology supposed that the egg consisted of homogeneous material which had to be differentiated into an organism. For this supernatural task supernatural agencies seemed to be required, and it is not surprising that many biologists imagined some quasi-superhuman intelligence which presided over the development of life. But when it is found that the unfertilized egg contains the rough structure, whose creation is due to the fact that the egg is laid down a little at a time in the ovary, Dr. Loeb thinks there should be no difficulty about discarding the superstitious view and seeing merely mechanical processes.

5. If a piece of twig is cut from a willow or rose, and stuck in the ground, leaves will grow from the upper end and roots from the lower; so that the part regenerates the whole original plant. Similar effects can be produced in lower animals, and even in higher animals a part which is cut off may grow again. Is there anything mysterious about this power? Must it be supposed, with G. Wolf, that the organism has a knowledge of its own needs; or that there is some intelligent guidance of it, either inside or outside of it? On the contrary, Dr. Loeb says, "it can be shown that the organism does in this case what it is compelled to do by its physical and chemical structure." There is no miracle to be found here, unless one also finds a miracle in the fact that water runs down hill. To state the case as simply as possible, it may be said that there are certain organ-producing substances constantly in circulation in a plant or animal. As long as these circulate, they do not produce organs; but if their circulation is stopped, they start growth at the point where they collect. Thus in the geranium-cutting which is planted in sand by the gardener, there are root-producing substances and leaf-producing substances in circulation. The leaf-producing substances flow toward the apex, are stopped there, and give rise to the production of leaf-buds. The root-producing substances, which are being carried toward the base, collect at the base and start the formation of roots. The existence of these specific organ forming substances is now well demonstrated; they are now known as "internal secretions" or "hormones."

THE PROBLEM OF INSTINCTS

6. So far, it may be said, the mechanist has had relatively easy problems. The problem of development itself might even offer no embarrassment; but how can he explain the complicated instincts which make for species preservation and perpetuation?

"The idea that the organism as a whole cannot be explained from a physicochemical viewpoint rests most strongly on the existence of animal instincts and will. Many of the instinctive actions are 'purposeful,' *i. e.*, assisting to preserve the individual and the race. This again suggests 'design' and a designing 'force,' which we do not find in the realm of physics. We must remember, however, that there was a time when the same 'purposefulness' was believed to exist in the cosmos where everything seemed to turn literally and metaphorically around the earth, the abode of man. In the latter case, the anthropo- or geocentric view came to an end when it was shown that the motions of the planets were regulated by Newton's law and

[3] This view has been well criticised by L. C. Dunn: Nucleus and cytoplasm as vehicles of heredity. American Naturalist vol. li, pp. 286-301, May, 1917.

that there was no room left for the activities of a guiding power. Likewise, in the realm of instincts, when it can be shown that these instincts may be reduced to elementary physico-chemical laws the assumption of design becomes superfluous.

"If we look at the instincts purely as observers we might well get the impression that they cannot be explained in mechanistic terms. We need only consider what mysticism apparently surrounds all those instincts by which the two sexes are brought together and by which the entrance of the spermatozoön into the egg is secured; or the remarkable instincts which result in providing food and shelter for the young generation.

"We have already had occasion to record some cases of instincts which suggest the possibility of physico-chemical explanation; for example, the curious experiment of Steinach on the reversal of the sexual instincts of the male [rat] whose testes had been exchanged for ovaries. There is little doubt that in this case the sexual activities of each sex are determined by specific substances formed in the interstitial tissue of the ovary and testis. The chemical isolation of the active substances and an investigation of their action upon the various parts of the body would seem to promise further progress along this line.

"Marchal's observations on the laying of eggs by the naturally sterile worker wasps are a similar case. The fact that such workers lay eggs when the queen is removed or when they are taken away from the larvae may be considered as a manifestation of one of those wonderful instincts which form the delight of readers of Maeterlinck's romances from insect life. Imagine the social foresight of the sterile workers who when the occasion demands it 'raise' eggs to preserve the stock from extinction! And yet what really happens is that these workers, when there are no larvae, can consume the food which would otherwise have been devoured by the larvae; and some substance contained in this food induces the development of eggs in the otherwise dormant ovaries." What appeared at first sight as a mysterious social instinct is revealed as a simple and commonplace effect of nutrition.

REACTIONS TO LIGHT

"If we wish to show in an unmistakeable way the mechanistic character of instincts we must be able to reduce them to laws which are also valid in physics. That instinct, or rather that group of instincts, for which this has been accomplished is the reaction of organisms to light. The reader is familiar with the tendency of many insects to fly into the flame. It can be shown that many animals, from the lowest forms up to the fishes, are at certain stages—very often the larval stage—of their existence slaves to the light."

Numerous experiments are cited which do indeed prove conclusively that many animals react to light in a perfectly definite way. A tendency to move when stimulated by light is called heliotropism. "A most interesting example of the rôle of heliotropism in the preservation of a species is shown in the caterpillars of *Porthesia chrysorrhoea*. The butterfly lays its eggs upon a shrub. The larvae hatch late in the fall and hibernate in a nest on the shrub, as a rule not far from the ground. As soon as the temperature reaches a certain height, they leave the nest; under natural conditions, this happens in the spring when the first leaves have begun to form on the shrub. (The larvae can, however, be induced to leave the nest at any time in the winter, provided the temperature is raised sufficiently.) After leaving the nest they crawl directly upward on the shrub where they find the leaves on which they feed. Should the caterpillars move down the shrub, they would starve to death, but this they never do. What gives the caterpillar this never-failing certainty which saves its life, and for which a human being might envy the little larva? Is it a dim recollection of experiences of former generations? It can be shown that it is the light reflected from the sky which guides the animal upward. When we put these animals into a horizontal

IMMATURE WASPS IN THEIR CELLS

When a crop of neuters or workers has been produced in the wasp nest, these begin to expand the size of the nest, while the original female or queen continues to lay eggs. The young larvae, in the stage shown at the left of the photograph above, are fed by the workers; later they go through a quiet period of pupation, as shown at the right, after which they issue forth to take up the work of the colony. All these neuters (functionless females) are produced by fertilized eggs; they receive an inheritance from two parents. The fact that they are sexually functionless is apparently due to a lack of something in their food. Photograph by Brown and Dawson. (Fig. 22.)

test-tube in a room, they all crawl toward the window, or toward a lamp; the animal is positively heliotropic. It is this positive heliotropism which makes them move upward where they find their food, when the mild air of the spring calls them forth from their nest. At the top of the branch, they come in contact with a leaf, and chemical or tactile influences set the mandibles of the young caterpillar into activity. If we put these larvae into closed test-tubes which lie with their longitudinal axes at right angles to a window, they will all migrate to the window end, where they stay and starve, even if their favorite leaves are close behind them. They are slaves of the light.

"The few young leaves on top of a twig are quickly eaten by the caterpillar. The light, which saved its life by making it creep upward where it finds food, would cause it to starve could it not free itself from the bondage of positive heliotropism. The animal, after having eaten, is no longer a slave of the light, but can and does creep downward. It can be shown that a caterpillar, after having fed, loses its positive heliotropism almost completely and permanently. If we submit unfed and fed caterpillars of the same nest contained in two different test-tubes to the same artificial or natural source of light, the unfed will creep to the light and stay there until they die, while those that have eaten will pay little or no attention to the light. Their sensitiveness to light has disappeared; after having eaten they become independent of light and can creep in any direction. The restlessness which accompanies the condition of hunger makes the animal creep downward—which is the only direction open to it—where it finds new young leaves on which it can feed. The wonderful hereditary instinct, upon which the life of the animal depends, is its positive heliotropism in its unfed condition and its loss of this heliotropism after having eaten."

There is no room for mysticism in explanation of this tropism, because it can be imitated artificially, as in a wooden "dog" with eyes of selenium, which John Hays Hammond, Jr., manufactured several years ago. This was mounted on wheels, and the action of light on the selenium influenced motors attached to these wheels. The "dog" would, therefore, follow a man with a lantern, even if the man walked in circles or zigzags. It is certain that the heliotropism of the animals above described is of a similar character, sensitive areas in the eyes or on the surface of the body being stimulated by light and communicating an impulse to the muscles, directly or indirectly.

If in several critical cases the existence of highly specialized instincts can be explained on a purely mechanical basis, as above, Dr. Loeb thinks it unscientific to bring in mystical influences, of a kind not capable of investigation, to account for other instincts.

7. It is equally important, in Dr. Loeb's view, to avoid any mysticism in thinking about the relation of the environment to the organism. The very term "environment," he objects, has a vagueness that is almost mystical; if instead of this the definite parts of the environment, such as temperature, moisture, saltiness of sea water, etc., were spoken of, it would make for clearer thinking. When these different elements of the environment are tested it is found, *if disturbing influences can be avoided*, that a living organism reacts just as precisely as a thermometer.

Again, the question of adaptation to the environment leads to a lot of loose thinking. It is sometimes supposed that the environment can cause an adaptive modification of the organism, and that such a modification may even be hereditary; but there are striking cases which warn against the falseness of this explanation of the origin of characters. Heliotropism, for example, might be supposed to be due to the inheritance of the effects of light on many generations of caterpillars; but it is found that caterpillars which spend their lives under the bark of willow trees and a shellfish which spends its life in the mud, are likewise heliotropic although neither of these has ever had, so far as is known, a chance to make

use of this capacity. "We understand today why this should be so, since heliotropism depends upon the presence of photosensitive substances, and it can readily be seen that the question of use or disuse has nothing to do with the production of certain harmless chemical compounds in the body."

USELESS CAPACITIES

A more striking case is that of galvanotropism. Dr. Loeb showed long ago that many animals react in a very definite way to a galvanic current, being made to move toward one of the electrodes; yet no animal in a state of nature has ever been subjected to a continuous electric current. This capacity, then, could not possibly have been evolved through use, nor can natural selection have had anything to do wth it. It is equally a puzzle to the vitalist who thinks that every part of an animal is given to it for some purpose. "The only consistent attitude is that of the physicist who assumes that the reactions and structures of animals are consequences of the chemical and physical forces, which no more serve a purpose than those forces responsible for the solar systems. From this viewpoint it is comprehensible why utterly useless tropisms or structures should occur in animals."

A famous case for the apparent adaptation of animals to environment has been the blind cave animals. It is known that in caves blind salamanders, blind fishes and blind insects are common, while such forms are comparatively rare in the open. This fact has suggested the idea that the darkness of the cave was responsible for the degeneration of the eyes. But some species of cave-salamanders are blind, while others are not. If disuse is the cause, why are they not all blind alike? Again, a blind fish is found living in the open water, off the coast of southern California. Why is it blind, in spite of constant exposure to the light?

Recent experiments with fish have shown that blindness can be produced in more than one way: (1) when wide crosses are made, blind embryos are frequently produced; (2) the eyes fail to develop if the temperature is kept very low; and finally (3) blind fish can be produced if certain chemicals are added to the water.

The true explanation of the frequency of blind fish in caves then is fairly obvious. Animals born with defects which would handicap them in open water may survive in a cave, and if they accidentally wander into a cave, they will perpetuate themselves there. The cave is not responsible for producing the blindness, but merely for allowing a blind form to live. The idea that the cave adapts its inmates to life under cave conditions, is, therefore, a misinterpretation.

"This attitude leaves us in a quandary. The whole animated world is seemingly a symphony of adaptation. We have already mentioned the eye with its refractive media so well curved and placed that a more or less perfect image of outside objects is focussed exactly on the retina; and this in spite of the fact that lens and retina develop independently; we have mentioned and discussed the cases of instincts or automatic arrangements which are required to perpetuate life—the attraction of the two sexes and the automatic mechanisms by which egg and sperm are brought together; the maternal instincts by which the young are taken care of; and all those adaptations by which animals get their food and the suitable conditions of preservation. Can we understand all these adaptations without a belief in the heredity of acquired characters? As a matter of fact the tenacity with which some authors cling to such a belief is dictated by the idea that this is the only alternative to the supernaturalistic or vitalistic ideas. The writer is of the opinion that we do not need to depend on the assumption of the heredity of acquired characters, but that physiological chemistry is adequate for the purpose."

FORMATION OF THE EYE

The formation of the eye is a good test case. Uhlenhuth transplanted the eyes of young salamanders into different parts of their bodies where they

were no longer connected with the optic nerves. The eyes after transplantation underwent a degeneration which was followed by a complete regeneration. He showed that this regeneration took place in complete darkness and that the transplanted eyes remained normal in salamanders kept in the dark for fifteen months. Lewis has shown that if the optic cup is transplanted under the skin of a young larva into any part of the body, the skin in contact with the optic cup will form a lens. It appears then that the formation of the lens is due to some chemical substance secreted by the optic cup; that the development of the eye is quite independent of the brain; and that it is quite independent of light. It is an automatic, self-regulating process.

"Examples might be multiplied indefinitely. They all indicate that apparent morphological and instinctive adaptations are merely caused by chemical substances formed in the organism and that there is no reason for postulating the inheritance of acquired characters. We must not forget that there are just as many cases where chemical substances circulating in the body lead to indifferent or harmful results." As an example of the first type is heliotropism in animals living in the dark, and galvanotropism in all animals; an example of the second type is hereditary color-blindness in man.

It is sometimes supposed that a mystical force tends to produce harmonious organisms. As a matter of fact, all kinds of disharmonies are being constantly produced; but they do not survive and therefore we are not reminded of their possible existence. Hence cases of apparent adaptation prevail in nature.

To illustrate how many possible disharmonies there are in nature for every harmony that exists, Dr. Loeb remarks that it is possible to fertilize the eggs of practically every marine bony fish with the sperm of practically every other marine bony fish; and as fertilization takes place more or less accidentally in the water, such cross-fertilizations must be constantly occurring. If they could all develop, the 10,000 kinds of marine bony fish now in existence would give rise to 100,000,000 new forms. But experiment shows that most of these hybrids have a defective circulation, and only a fraction of 1 per cent can live. It is therefore, no exaggeration to state that the number of species existing today is only an extremely small fraction of those which can and possibly do originate, but which escape notice and disappear because they cannot live or reproduce.

From such facts, Dr. Loeb concludes that the laws of chance are sufficient to account for all the apparently purposeful adaptations. If an intelligence really were directing evolution, it would have to stand convicted of extraordinary bungling.

THE NATURE OF DEATH

8. It is an old saying that one cannot understand life unless he understands death; hence Dr. Loeb devotes his last chapter to a discussion of the death and dissolution of the organism. The dead body undergoes disintegration; hence it was natural to argue that life is that which resists this tendency to disintegration. "The older observers thought that the forces of nature determined the decay, while the vital force resisted it. This idea found its tersest expression in the definition of Bichat, that 'life is the sum total of the forces which resist death.'" But such talk is to Dr. Loeb intolerably mystical. Analyze it, and nothing definite remains. It offers no useful knowledge, it points to no processes which can be weighed, measured, or counted. "Science is not the field of definition, but of prediction and control. The problem is: first, how does it happen that as soon as respiration has ceased only for a few minutes the human body is dead, that is to say, will commence to undergo disintegration; and, second, what protects the body from this decay while respiration goes on, although temperature and moisture are such as to favor decay?"

The question recalls that problem of the older biologists: why does not the stomach digest itself? As a fact, it

THE FRONT OF A WASP'S NEST

The cells of the nest are not allowed to remain idle: as soon as one wasp emerges, the cell is cleaned out and another egg laid in it. Later in the fall the queen's supply of fertilized eggs is exhausted, and she then lays eggs which have never been fertilized. They contain no inheritance from a male parent, but represent only a mother. These unfertilized eggs develop into males who, after fertilizing the females, quickly perish. The neuters likewise perish at the beginning of cold weather, and the only members of the colony who survive are the fertilized females, who are ready in the spring to start nests of their own. Photograph by Brown and Dawson. (Fig. 23.)

does so as soon as the individual is dead, but not during life. Recent work has shown that the power of self-digestion is shared by all organs and tissues. What keeps it in check? Oxygen, probably. When the oxygen is shut off, disintegration begins; and in the higher animals this will occur if the oxygen is absent for only a few minutes. It is possible that the brain cells which control respiration are particularly delicate and sensitive, and are irreparably injured by the absence of oxygen for a short time. Therefore, suffocation causes the death of the whole body, because the heart-beats must cease after respiration does, and therefore the nutritive solution which the blood carries to all the cells is shut off and they break down. Every cell in the body of a mammal is potentially immortal, it is now believed, but they are so specialized, so dependent on each other, that the destruction of the nerve cells which control respiration quickly entails the death of all the rest.

What is commonly called "life" is to Dr. Loeb merely a chain of chemical reactions. Death is merely the breaking of the chain, the interruption of the series.

SUMMARY

9. It may now be useful to sum up the doctrine of the book in Dr. Loeb's own words.

"It is generally admitted that the individual physiological processes, such as digestion, metabolism, the production of heat or of electricity, are of a purely physicochemical character; and it is also conceded that the functions of individual organs, such as the eye or the ear, are to be analyzed from the viewpoint of the physicist. When, however, the biologist is confronted with the fact that in the organism the parts are so adapted to each other as to give rise to a harmonious whole; and that the organisms are endowed with structures and instincts calculated to prolong their life and perpetuate their race, doubts as to the adequacy of a purely physicochemical viewpoint in biology may arise. The difficulties besetting the biologist in this problem have been rather increased than diminished by the discovery of Mendelian heredity, according to which each character is transmitted independently of any other character. Since the number of Mendelian characters in each organism is large, the possibility must be faced that the organism is merely a mosaic of independent hereditary characters. If this be the case the question arises: What moulds these independent characters into a harmonious whole?

"The vitalist settles this question by assuming the existence of a pre-established design for each organism and of a guiding force or principle which directs the working out of this design. Such assumptions remove the problem of accounting for the harmonious character of the organism from the field of physics or chemistry. The theory of natural selection invokes neither design nor purpose, but it is incomplete since it disregards the physicochemical constitution of living matter about which little was known until recently.

"In this book an attempt is made to show that the unity of the organism is due to the fact that the egg (or rather its cytoplasm) is the future embryo upon which the Mendelian factors in the chromosomes can impress only individual characteristics, probably by giving rise to special hormones and enzymes. We can cause an egg to develop into an organism without a spermatozoön, but apparently we cannot make a spermatozoön develop into an organism without the cytoplasm of an egg, although sperm and egg nucleus transmit equally the Mendelian characters. The conception that the cytoplasm of the egg is already the embryo in the rough may be of importance also for the problem of evolution since it suggests the possibility that the genus- and species-heredity are determined by the cytoplasm of the egg, while the Mendelian hereditary characters cannot contribute at all or only to a limited extent to the formation of new species. Such an idea is supported by the work on immunity, which shows that genus- and probably species-specificity are due to specific proteins, while the

Mendelian characters may be determined by hormones which need neither be proteins nor specific or by enzymes which also need not be specific for the species of genus. Such a conception would remove the difficulties which the work on Mendelian heredity has seemingly created not only for the problem of evolution but also for the problem of the harmonious character of the organism as a whole."

THE SURVIVAL OF THE FITTEST

Above all, the rôle of blind chance must be emphasized. Harmonious combinations finally are evolved, because an immense number of combinations has been tried and the unsuccessful ones rejected. Many failures are destroyed, even today, in the struggle for existence; and the multiplication of creations has been going on for perhaps a billion years. In each generation many new combinations were produced by chance; most of them were incapable of living but the occasional one that represented better adaptation to its surroundings lived and multiplied.

10. No one would claim that science today can offer a mechanical explanation of all the problems of life. But in the mechanist's view, so many seemingly metaphysical problems have yielded to a physicochemical explanation, that there is no justification for denying that all the rest can probably be explained in the same way, as scientific research proceeds. The idea that "living" matter contains some "vital principle" which makes it different in kind from "dead" matter is to him worthless. The idea that the development of the embryo is controlled by some invisible guiding force, some mysterious influence of an unascertainable nature, following a mystically preestablished plan or design, is for him obsolete. He sees no room in the body for any soul, no room in the world for any directing force except the kind of chance that governs the fall of dice from a box. The "mystery of life" is for him a mystery in the sense that it is so complicated as to be difficult of investigation. In any other sense, he would admit no more mystery in life than in the effervescence of a seidlitz powder.

A. G. A. Publications Wanted

Many of the publications of the American Genetic Association are out of print, and it is impossible for members who desire to complete their files, or to obtain complete sets, to do so. The following numbers of the association's magazine are particularly in demand for this purpose:

American Breeders' Magazine, Vol. iii, No. 4.

JOURNAL OF HEREDITY, Vol. v (1914), No. 1.

JOURNAL OF HEREDITY, Vol. vii (1916), Nos. 1, 2, and 4.

The secretary of the association will be glad to receive copies of any of the above, in good condition. He will exchange for any one of them a copy of Vol. vi, Proceedings of the American Breeders' Association (a description of which will be found on the inside back cover of this issue), or will credit a member with three months' extension of his membership, for each one of the above magazines returned.

The Prevention of Crime

Expenses for crime in Ohio increased six and one-half times as rapidly as the population in eight years, 1906–1914, says Dr. Thomas H. Haines in Bulletin No. 5 of the Bureau of Juvenile Research. The best way to remedy this is to remove the causes of crime, and the best way to get at the causes is to study the young offenders. Hence Ohio established a State clinic for all convicted young offenders, and before any young delinquent is sentenced, a radical search for the causes of his delinquency is made. This Bureau, of which Dr. Haines is clinical director, has taken an enlightened stand in eugenics.

WHEAT-RYE HYBRIDS

Edgar A. McFadden, *Brookings, S. D.*

I WAS greatly interested in the article, "Carman's Wheat-Rye Hybrids," by C. E. Leighty, which appeared in the September, 1916, issue of this magazine. Mr. Carman's experience with wheat-rye hybrids as noted in the article referred to is very similar in many respects to an experiment conducted by myself during the past three years.

During the summer of 1915, having in mind the production of a hardy winter wheat that would withstand the severe winters of the Dakotas, I attempted to produce some hybrids between wheat and rye. At that time I knew nothing of Mr. Carman's experiments with wheat-rye hybrids, but the fact that rye was very winter-hardy and a close relative of wheat led me to believe that a cross between these two cereals might result in a variety having the hardiness of rye combined with the milling qualities and other desirable characteristics of wheat.

The varieties chosen for hybridization were Turkey winter wheat and Swedish rye, two of the hardiest varieties of their respective classes. The flowers on nine of the wheat heads were carefully emasculated, after which pollen from the rye was dusted upon the stigmas. The heads were then wrapped in tissue paper to protect them from foreign pollen. As a result of this treatment nine of the flowers pollinated set seed, an average of one seed for each head, none of the heads setting more than three seeds. Most of these seeds were badly shrunken and distorted in appearance, and upon being planted that fall, only two out of the nine grew. These two supposedly hybrid plants came through the winter in perfect condition but upon heading out the following summer, one of them proved to be a typical wheat plant, probably the result of self-fertilization. The other plant was a true hybrid, possessing some of the characteristics of each parent, but could easily be mistaken for a pure wheat plant.

The most noteworthy differences between the hybrid plant and its parents were in the number of spikelets on the normal spikes, and the length of the culms. The female parent (wheat) has, normally, eight or nine pairs of spikelets per spike, while the male parent (rye) has from sixteen to twenty. The length of the culms in wheat is also considerably less than that of the rye. The hybrid plant contained fourteen to sixteen paired spikelets per spike with culms intermediate in length between the two parents. It was uncommonly thrifty in appearance, and produced twenty-five vigorous culms that developed heads, and also several tillers that did not develop fully. The first spikes to appear produced no seed, the cause of which was revealed by the microscope which showed that, although anthers were present, yet no normal pollen grains were developed. The flowers on a few of the later spikes were hand-pollinated with pollen from Kharkov winter wheat, as a result of which three seeds were produced. These seeds were planted last fall, and two of them grew and produced vigorous plants neither of which survived the past winter. If hardiness is assumed to be a recessive unit character, then one could not expect these hybrid plants to survive a winter like the past in which nearly all unprotected wheat plants succumbed. Working on this assumption, hybridization work along the same line will be continued this summer on a larger scale, and the F_1 and F_2 plants carried through the winter in the greenhouse.

RYE　　WHEAT × RYE　　WHEAT

A WHEAT-RYE HYBRID AND ITS PARENTS

The cross between wheat and rye is believed to promise the production of a grain that would be valuable for its hardiness; but it is an extremely difficult cross to make, and most attempts fail. Photograph ¾ natural size. (Fig. 24.)

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

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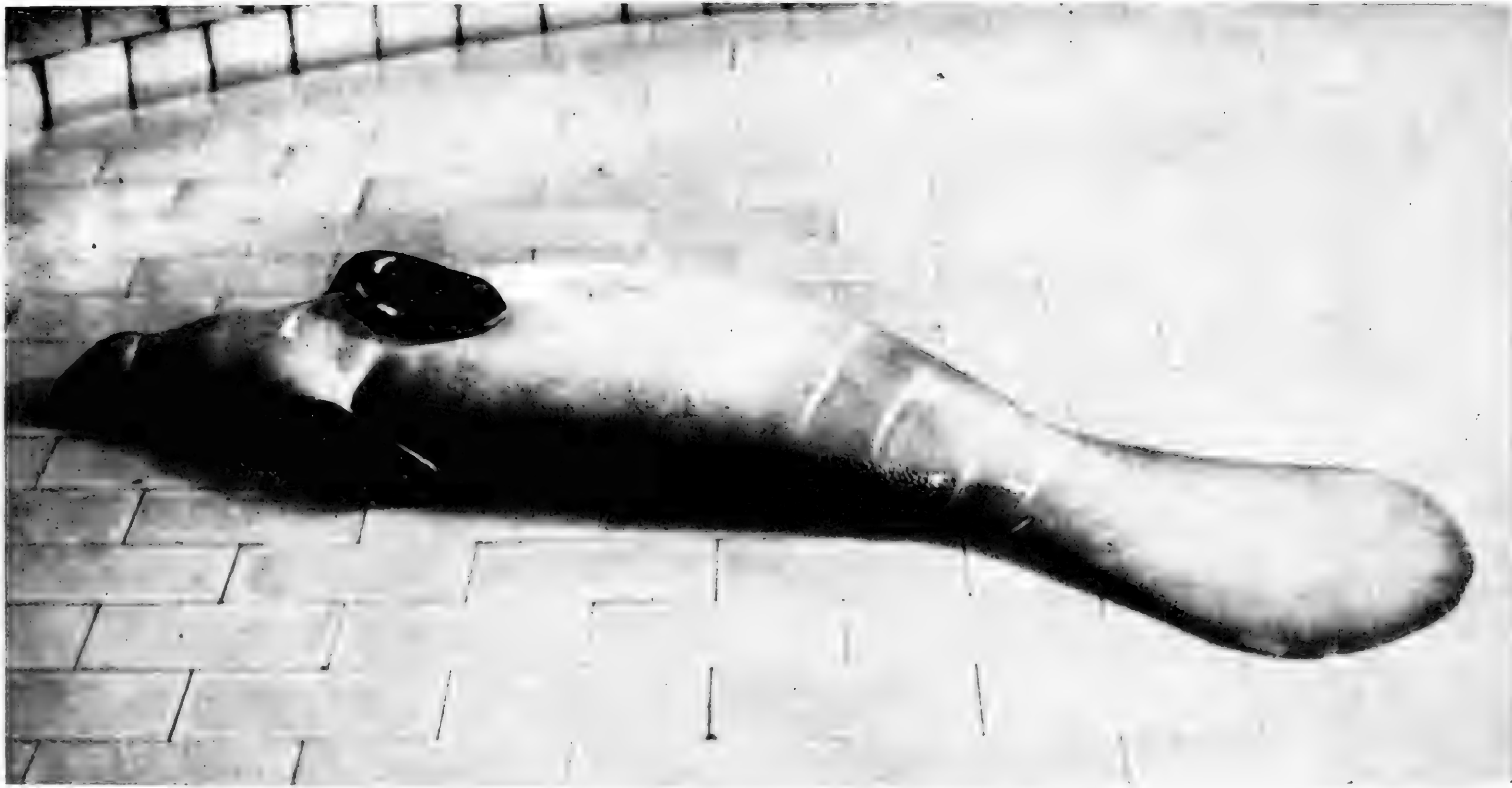

A MANATEE OR SEA-COW FROM THE AMAZON

Manatees of several different species are found in the warmer Atlantic waters of America, sometimes coming as far north as Virginia. The buccaneers of the West Indies and Spanish Main prized them as a source of meat, oil and leather. They are so defenseless that they have been almost exterminated in the waters of the United States, but could probably be increased without difficulty if cared for. The above photograph shows a manatee on its back, a position the animal assumes in order to avoid injury to his flippers, when the water is let out of his tank. Photograph from the New York Zoōlogical Society. (Frontispiece.)

A NEW FOOD MAMMAL

Utilization of Florida Manatee Suggested by Alexander Graham Bell—Offers Promise of Easy Domestication, Eats Food that Is not now Used, Would Occupy no Agricultural Land, and Furnishes a Meat That Is Said To Be Delicious

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THE shortage of meat and the high price of fodder make the time seem opportune to call attention to a food animal which produces a delicious meat, which recent investigations indicate would be easy of domestication, which lives upon an aquatic forage plant as rich in nutriment as cow pea hay and which has, up to the present time, been so totally neglected as to be threatened by extermination.

Dr. Alexander Graham Bell is originator of the idea, which is first expressed in this article, that we have, so to speak, a new domesticated mammal worthy of serious consideration in connection with the growing shortage in the meat supply of the world and it is to his initiative that is due the preliminary investigation made in Florida this last winter and the search through the literature which has resulted in the present brief article.

Compared with the pigmy hippopotamus[1] as a food animal, the manatee has many points of superiority. It can do no harm, it lives on food plants not now utilized, and it is literally like the fish in our streams at our very door and not in Africa.

Florida has passed a law protecting it; let the State or Federal Government now pass an act to investigate the possibilities in it of a new animal industry for Southern Florida.

The manatee,[2] which has received the popular name of sea-cow, is a docile, easily domesticated mammal resembling a long-bodied seal in appearance. There are no hind limbs, but a broad, rounded tail, which forms a powerful propeller in swimming. The skin is naked like that of an elephant, sparsely covered with hairs and about one inch thick. The animal attains a maximum length of 15 to 18 feet, and old bulls weigh as much as half or three quarters of a ton. The fore limbs are flipper-shaped and anything but graceful, but they are of good size and are used for holding food and conveying it to the mouth. The female carries her young beneath the flipper and suckles it in this position, a circumstance which probably gave rise to the mermaid myth, since the upper portion of the body is out of the water at the time. Columbus states that he saw three mermaids on his first voyage to

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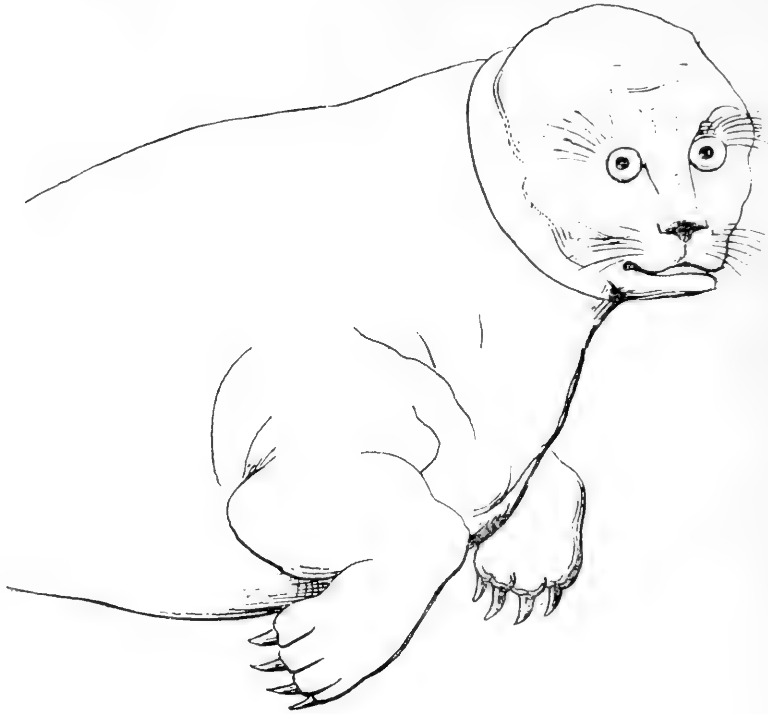
[1] The possibility of utilizing the southern swamps for the breeding of this hippopotamus was discussed in the JOURNAL OF HEREDITY, V, pp. 34–37, January, 1914.

[2] The Florida manatee is scientifically known as *Trichechus latirostris*. The appellation "manatee," or as it was originally spelled, "manati," refers to the use of the flippers as hands in conveying food to the mouth and in suckling the young.

Two other species of manatee are known besides that which inhabits Florida; *T. inunguis*, which frequents the Atlantic shore from Mexico as far as the twentieth parallel of latitude south, and *T. senegalensis*, which lives along the shores of Africa and in the Indian Ocean. All three species are so similar that distinct limits to their respective habitats can hardly be marked.

The only other existing family of the Sirenia is the Dugong or Halicore. *D. dugon* inhabits Africa, the Red Sea, Ceylon, India, and the Malay Archipelago, *D. australis* inhabiting the coasts of Australia. The dugong is more distinctly marine than the manatee. The distinguishing mark between the two is the tail. That of the dugong is fluted and shaped like that of a whale, while the manatee possesses a broad, flat tail which is almost circular in form.

The Sirenia form a group apart, and although they have many apparent affinities with other existing animal orders, it has been impossible to establish any certain connection. Some believe that the elephant and manatee are both descended from the same stock: others place the Sirenia midway between the elephants and the porpoises.



AN OLD MAN OF THE SEA

Medieval writers gave the name of *phoca* to various marine animals which in form faintly resembled a human being. Manatees, dugongs, seals, walruses, etc., all seem to have been regarded as one species under this name, and to have been identified loosely with mermaids and tritons. Ambrosinus gives the above picture of what he calls *senex maris*, an old man of the sea. Natives around the Red Sea, it is said, took these creatures to be the survivors of Pharaoh's Army, drowned in the pursuit of the Children of Israel. (Fig. 1.)

the West Indies, but that they were not as charming as he had been led to believe.

MERMAIDS OF THE NEW WORLD

While sailing in the river near the harbor of St. John's, in 1610, Capt. Johann Schmidt relates that he saw a marine creature which resembled greatly a human being with flowing hair and the face of a maiden (Fig. 2) swimming rapidly toward him. This peculiar being did not, however, have the usual timidity of her sex, and seemed to wish to overtake the captain, who fled hastily in order to avoid her. She then made toward the part of the ship where Wilhelm Hacobridge, the captain's servant, was stationed. But the members of the crew also had no desire to make a closer acquaintance with this strange creature, and seizing some sticks, they beat the visitor unmercifully, until she turned and disappeared under the water.

If the author of *Telliamed* is credible, Sirens and Tritons were formerly quite common at Martinique. He cites an affidavit of Pierre Luce, a nobleman, sworn to on May 31, 1761, before Pierre de Béville, a notary, in the presence of Père Julien Simon, Jesuit, and three other witnesses. The statement was sworn to by two Frenchmen and four negroes who, on the twenty-third day of the same month, had gone to the Isles of the Diamond in a boat to fish. When returning near sunset they noticed, near the shore of the small islet on which they were situated, a marine monster having human form from the

A SIREN OF THE AMERICAN COAST

The manatees found in the Atlantic waters of America were taken by early travelers for mermaids and mermen, and some of the descriptions do credit to the imagination of the old voyagers. The above drawing, from an old chronicle, shows the mermaid which appeared to Captain Schmidt and his crew off the coast of Newfoundland, in the year 1610. To the unromantic modern eye, these "mermaids" are far from seductive in appearance (see Fig. 3), but may furnish a valuable meat supply. (Fig. 2.)

waist up and terminating below in the tail of a fish. The head was the size and shape of a man's head, and was covered with black hair, mixed with gray, which hung down over his shoulders. His face was large and round, the nose large and flat, eyes of regular shape, the ears large, a beard of 6 or 8 inches in length and mixed with grey like the hair, while his stomach was also covered with the same kind of hair. His arms and hands were like those of a man, and upon coming out of the water, which he did twice, he appeared to wipe his face. When he raised himself out of the water, the part of his body above the waist appeared to be that of a young man of 15 or 16 years of age, the skin being quite white. The length of the whole body appeared to be about five feet. He regarded the men one after the other for some minutes without appearing surprised. When they first noticed him, he was not more than seven feet from the rock on which they stood, and after submerging, he next appeared about four feet distant, and plunging a third time he came up less than three feet away, so close that one of the men offered him his line to see if he could capture him. The creature then turned and swam away, and again plunging below the surface was lost to sight.

A MONOGAMOUS ANIMAL

To return from mythical to real manatees—they are evidently monogamous in their natural state, but since the dead mate is apparently not mourned by the living animal, it seems likely that one male would be sufficient to take care of a number of females. They breed in small lagoons and bayous and have one or two calves, the period of gestation being probably about eight months. The family commonly consists of four—the adult pair, one half-grown individual and the calf which is generally born in the autumn.

Due to its peculiar anatomy, it is impossible for the manatee to leave the water, and any stories to that effect, if traced down, will be found to be

A FLORIDA MANATEE

Manatees are still found in a few of the inlets and bayous of Florida, and probably could be domesticated in many of the lakes. In captivity they eat almost any vegetable food that is offered, and are extremely docile. The specimen here shown is kept in a tank by Capt. C. H. Thompson of Miami. Photograph by David Fairchild. (Fig. 3.)

connected with some other animal. It is entirely inoffensive and is unable even to resist attack. Its survival in the struggle for existence is due to the fact that it never frequents the open seas, but stays in shallow water, where it is safe from predatory denizens of the deep, and being unable to go on land, it has escaped the pursuit of the land carnivores.

The animals is entirely herbivorous, and what is more strange, does all its eating under water. This is possible because the upper lip is cleft, and the lip pocket, together with the mouth, forms a combination similar to a canal lock system. In captivity, it will eat practically all vegetables and even bread.

Immediately beneath the inch-thick skin is a layer of blubber averaging 1½ inches in thickness. Beneath the latter is the meat, all of which is equally edible. The meat surrounds a skeleton of very simple construction, comprising a skull, vertebral column and strong, massive ribs, of great density.

The manatee has been observed as far north as Virginia, through the West Indies and in Florida, along the Gulf Coast and Mexico, and down the coast as far as the twentieth degree of south latitude. It ascends rivers for great distances. Since Captain Dampier, the explorer, speaks of the animal in the Guatemalan lakes, it is probable that it could exist in domestication in the Florida lakes equally well.

DR. BELL'S STATEMENT

Dr. Alexander Graham Bell writes:

"These huge and inoffensive creatures were fairly swarming in the rivers, bays and lagoons of Florida when the white man first came to America. In countless herds they grazed upon the sea weeds and water plants, just as the buffalo grazed upon the plains of the West. The flesh of the manatee was much prized and the creature was also valuable for its hide and oil. It was not found in the open sea far away from land, but inhabited the shallow waters in bays, lagoons and estuaries of rivers.

"It was an animal of from 9 to 12

GATHERING THE SUBMARINE MANATEE HAY

The principal food of the manatee in Florida is a remarkable grass which deserves attention from agriculturists. It is remarkably rich in nitrogen and contains over 2% of iron. Its long, soft stems nearly fill many of the creeks along the coast, and it can be harvested with a strong rake. Photograph by David Fairchild. (Fig. 4.)

feet in length—about the size of a cow, and was so easily caught that with the increase of the white population it was threatened with extinction. In fact, it has practically, like the buffalo, become extinct, although a protected herd still exists in the Miami River. With suitable protection this herd would again increase and might be made an important food supply for Florida and the world.

"There is no reason to doubt that herds could be easily kept in confinement in the lagoons of Florida, as private property."

An old writer paints this vivid picture of its nature:

"Their manners and dispositions are stated by voyagers to be inoffensive, mild and even amiable. Buffon states that they are both intelligent and sociable, not naturally afraid of man, but rather free to approach him and to follow him with confidence and promptitude. But they have especially a kindly feeling for their fellows. They usually associate in troops and crowd together with the young in the center, as if to preserve them from all harm; and when danger besets them each is willing to bear his share in mutual defense or attack.

"When one has been struck with the harpoon it has been noticed that the others will attempt to tear the dreadful weapon from the wounded flesh.

"When the cubs are captured, the mother becomes careless of her own preservation; and, should the mother be the victim, the young follow her fondly

to the shore, where they are speedily secured and slain."

LONGEVITY OF THE MANATEE

"Buffon also tells us that Gomara reared one in a lake in Santo Domingo, and preserved it for the long period of twenty-six years. It became so tame and familiar as to answer to its name, and took pleasantly whatever nourishment was offered."

The Brighton Museum in England kept a young male in a tank for sixteen months, during which time he throve remarkably and ate lettuce, cabbage, spinach, kale, baked apples, celery tops, etc. By accident, the water was drained out of his tank, and he was left on the bare floor during an exceptionally cold night. He died soon after as the result, but with proper care, there seems to be no reason why he should not have existed indefinitely.

In May, 1907, a bill was passed in the Florida Legislature, placing a fine of $500 on the killing of manatees. The manatees have increased wonderfully since the passing of the bill. Tourists have always had an insane desire to shoot the entirely helpless animals, but with a check of $500 laid on the act, few care to pay the price for the sport.

The dugong, the only family of the order Sirenia besides the manatee, is an animal which is practically identical with the manatee except in a few minor anatomical differences, and inhabits almost the whole tropical region of the Old World. Since the two species are practically identical in appearance, and no sharp line is drawn of the geographical distribution of the two groups, this article will consider them as identical, which they are, considered from an economic viewpoint.

The dugong is considered by the Malays as a royal *fish* and the king is entitled to all that are taken. The flesh is considered by them to be superior to that of the buffalo or ox. The affection of the mother for its young is very strongly marked, and the Malays make frequent allusion to this animal as an example of maternal affection. When they have taken the offspring they feel certain of the mother, and it is said that the young shed tears. These tears are, it is alleged, carefully preserved by the common people as a charm, the possession of which is supposed to secure the affections of those to whom they are attached, in the same manner as they attract the mother to her young.

Unlike many new meats, the flesh of the manatee is universally liked by every one who has tasted it. It is often compared to veal cutlets, although some have likened it to lean pork or tender beef, but all agree in praising its whiteness, delicacy and delicious flavor. When salted, it is like excellent bacon, and keeps well. The tail is often pickled and eaten cold, when it is considered a great delicacy. The buccaneers were accustomed to replenish their supplies by a drive on the manatees, and frequent testimonials in their writings bear witness to the high esteem in which they held the animal.

Dugong skin has long been used in the Red Sea region, and the Children of Israel are said to have covered the roof of their Tabernacle with it. Al-Kazwînî and Ibn-al-Wârdî, medieval Arab men of science, state that in the Sea of Al-Kulzûm (the Red Sea), is a "fish in the form of a cow, which bringeth forth its young and suckleth like a cow," and add, "shields are made of its skin." They later state that in the same sea are "fish shaped like camels, 20 cubits long, the back of which is (like) excellent tortoise shell, and it bringeth forth young and suckleth like human beings." Skin which could be used for covering shields and which was called "excellent tortoise shell" must certainly have been of durable quality. The reference to the camel probably refers to the position sometimes assumed by the dugong in arching its back.

A VALUABLE SKIN

Captain Dampier remarks that the skin of the manatee proved of much value to the buccaneers, who used it for their most strenuous work, including thole straps on their oars. The hides of the old bulls proved too heavy for the primitive methods employed, but

shaved strips were used as horsewhips. When simply dried, the skin was as hard as wood, and dried and twisted strips of the skin afforded serviceable walking-sticks. It is said that native shields which were covered with manatee skin were proof against musket bullets.

The thick layer of blubber which surrounds the entire body furnishes an oil which is also of much value. It is proclaimed as equal therapeutically to cod liver oil, and is, in addition, odorless and practically tasteless and contains no iodine. It is clear, limpid and cleanly, and old writers often remark that it never "rusts" or becomes rancid.

Because of the unusual density, shape and size of the bones, they would make a good substitute for ivory. They take a high polish without cracking, and have no central cavity. Since there are few small bones, the vertebral column and heavy ribs supporting the entire body, practically the entire osseous portion of the body would be available.

With good veal, bacon, ham, beef, chops and other similar meats now retailing at an average of 50 cents a pound, with 85% of the animal available as saleable meat, the economic worth of an animal weighing possibly half a ton and as well constructed for the cutting of saleable meat as is the manatee is easily seen. Although under modern packing house conditions absolutely nothing is wasted, it seems probable that the manatee would be more economically handled in the abattoir than are many other animals now being used.

The natural food of the manatee is commonly known as manatee grass, technically *Cymodocea manatorum.* It grows in the rivers of Florida in enormous quantities, with stems often four feet long, lying dormant in winter, but in summer almost filling the river. It is easily pulled up with a rake with strong teeth, and a man can gather a boatload of it in an hour or two. The following table[3] compares manatee grass with other kinds of hay in common use:

	Manatee grass %	*Alfalfa* %	*Clover* %	*Timothy* %	*Cow pea* %
Moisture...	8.7	8.4	15.3	13.2	10.7
Ash.......	12.9	7.4	6.2	4.4	7.5
Ether extract.....	2.1	2.2	3.3	2.5	2.2
Protein.....	16.6	14.3	12.3	5.9	16.6
Crude fiber.	19.6	25.0	24.8	29.0	20.1
Nitrogen free extract...	40.0	42.7	38.1	45.0	42.2
Iron (Fe_2O_3).	2.46	....	....	....	....

It may be seen by comparing the analyses of the manatee grass and cow pea that the two are almost identical chemically. The manatee grass might be called an aquatic cow pea. Such a promising plant should receive further investigation regarding the cost of cultivation and the area already occupied by it. Dr. Alsberg states that the amount of iron in the manatee grass is remarkable. The plant is so soft and tender that little tufts of it can be easily twisted to pieces with the hands.

In sum, the manatee can probably be reared easily in the warm, shallow waters of the Southern states, which are now unproductive. A manatee will apparently furnish as much meat as a steer, will possibly increase as rapidly, can be easily cared for, and may involve less expense. Manatee breeding as a commercial enterprise in the lakes, inlets and rivers where the climate is warm enough, looks like a feasible, profitable and useful undertaking. Animal breeders should take it up, and should be encouraged by some suitable governmental action.

[3] The analysis of Cymodocea is that made by the Federal Bureau of Chemistry, through Dr. Carl L. Alsberg, and that of alfalfa from *Farmers' Bulletin* 339, by J. M. Westgate.

MORE POTATOES

Growers Might Double Size of American Crop on Present Acreage by More Scientific Cultivation and by Selecting Entire Hills, instead of Single Tubers, for Planting—United States far Behind European Growers in Potato Production

MORE than five thousand million bushels of potatoes are grown in the world in a normal year. That would allow 5 bushels, or about eight hundred fair-sized tubers, for each man, woman, and child on the face of the globe—not only for the persons who eat potatoes, but for the Eskimo, the Chinese, and the Hottentot, who do not.

No other crop comes within a billion bushels of this total. The potato is, in amount of yield, incomparably the chief food plant of the world.

The Western Hemisphere has little share in this production. South America, the home of the potato, now grows only 7 bushels in every thousand that the world uses, while the United States produces but 6% of the total crop.

As far as the United States is concerned, this low position is mainly due to the inferior methods of planting and cultivating, which are in general use. The Englishman or German grows more than twice as many potatoes on an acre of ground, as does the American—in fact, the average yield in the United States is little more than half a pound per plant, *and a single good tuber weighs more than that.* This shameful showing is partly due to the fact that the climate of the United States is hotter and drier than might be desired for potato-growing; it is partly due to the fact that European potatoes are often of a coarse but heavy-yielding variety, suitable only for stock food or starch and alcohol manufacture; it is partly due to the fact that Americans do not fertilize their land to the best advantage; but it is to a considerable degree due to the failure of Americans to use the most intelligent methods of selection of tubers they plant.

While a single hill, in the United States, yields on the average only half a pound of potatoes, a single hill in English experiments has produced 20 pounds. This shows that there is a variability which offers abundant chance for permanent improvement; and plenty of cases can be cited which prove that such improvement can be made. Spillman, for example, mentions a Michigan grower who "some years ago began the practice of digging by hand enough potatoes for seed, and saving only those hills that had six or more merchantable tubers and no small tubers. When he first began this practice, only sixteen hills out of each hundred dug came up to this standard, but after he had continued the practice for five years the number of such hills had risen to seventy in a hundred."

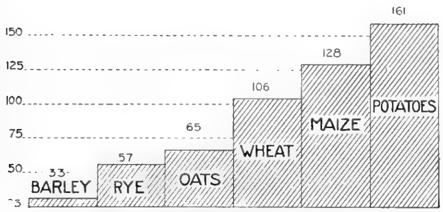
IMPROVEMENT IS IMPORTANT

The improvement of the American potato yield is thus entirely feasible, if a little thought is used. How great a change in the total would be caused by a very slight increase in the hill yield, is pointed out by Luther Burbank, who calculates that to add only one tuber to each hill would augment the annual crop by 21,000,000 bushels. If the half-pound average yield of American plants were doubled—an achievement that ought to be easily possible—the 3,500,000 acres planted to the crop in this country would produce enough potatoes so that every individual in the country could have 5½ bushels a year:[1] enough potatoes to insure an

[1] Surveys of many farm communities in the United States have shown that the consumption of Irish potatoes is often 5 bushels per person per year, or about 25 bushels per family. In potato-growing regions, it may be double this. It is evident that in large parts of the South, and among many elements of city populations, the consumption of potatoes must be small.

abundant and cheap supply for domestic use and a large exportable surplus.

With potatoes selling at $3 or $4 a bushel this spring, every householder has been obliged to realize that something is wrong with the American potato supply. The trouble lies partly in bad



FOOD CROPS OF THE WORLD

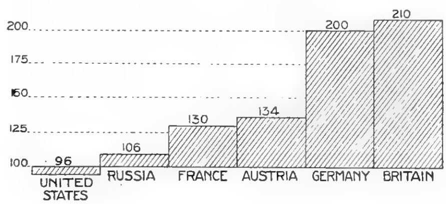
The figures show the annual yield in millions of tons, average for five years, 1908–1912. Rice is omitted, because the figures from large parts of China, where rice is extensively grown, cannot be obtained. Probably rice belongs between oats and wheat in the above diagram. Data after Gilbert. (Fig. 5.)

weather and plant-disease, but it is to some extent due to failure to apply knowledge that is the common property of every plant-breeder. A. W. Gilbert's book on "The Potato,"[2] is, therefore, timely, for Dr. Gilbert was long professor of plant-breeding at Cornell University and chairman of the plant-breeding section of the American Genetic Association, and naturally devotes particular attention to the problems which fall in the field of genetics.

"The principal method of improving the potato is by bud-selection," Dr. Gilbert says. "Potato hills are very variable, and improvement is made by planting the tubers from the best hills. Many of these apparent improvements may be due to some advantage in growth, such as increased fertility, more light or moisture, and so forth. Of course, this increase is only transitory, and not being inherited, produces no permanent advancement.

"The potato, however, presents variations which are inherited. These are of two kinds—smaller differences whose inheritance produces a gradual change, and large differences or so-called 'bud sports' or bud-mutants which immediately become the starting point of new varieties.

"Potatoes differ from most farm crops in their manner of reproduction. They are propagated vegetatively without the intervention of a sexual process like corn or wheat. Each hill of potatoes comes from one tuber or part of a tuber which was the product of one bud of the mother plant. Hence the entire hill becomes a unit, and hill selection is, in reality, bud selection. Single tubers cannot be said to be units from the breeder's standpoint. Therefore, it is of supreme importance to take into account the yield of an entire hill and



BUSHELS OF POTATOES PER ACRE

Germany and Great Britain get more than 200 bushels of potatoes from an acre of land. The United States does not do half as well as this, but might easily improve its showing. The figures show the average annual yields per acre for the years 1904–1914, after Gilbert. (Fig. 6.)

not the presence in it of two or three large tubers resulting in low total yield for the hill."

MASS SELECTION

"Until recently, the method of selection has been to choose from the potato

[2] The Potato, by Arthur W. Gilbert, Ph.D., formerly professor of plant-breeding, New York State College of Agriculture at Cornell University, assisted by Mortier F. Barrus, Ph.D., professor of plant pathology, New York State College of Agriculture, and Daniel Dean, formerly president of the New York State Potato Association. The Rural Science Series (edited by L. H. Bailey). Pp. 318, price $1.50 net. New York, the Macmillan Co., 66 Fifth Avenue, 1917.

bins in the spring the requisite amount of seed, using tubers having the desired shape and size but without knowledge of whether they came from high yielding strains or not. This method of choosing seed from year to year, using merely the best tubers without a knowledge of their ancestry or obtaining a test of their producing power, is known as 'mass-selection.' This method will inevitably lead to improvement because the very poor hills will not produce good tubers, and hence will be eliminated. But the improvement is a very slow one. In employing this method of mass selection, growers were working blindly without knowing how or when or even whether they were going to reach a stability of type."

Intelligent breeders have now discarded this method of picking the best tubers out of the bin without knowing anything about their past. In its place they use the method of pedigree-breeding, picking out the best hills for perpetuation, instead of the best single potatoes. The grower should have a vivid mental picture of the standard toward which he is working, and then should choose his seed-potatoes from those hills which, as a whole, most nearly meet his ideal.

Ideals for the perfect potatoes naturally vary with localities, but certain attributes are universally desired. Among these are:

1. High yield. This means not only a large number of potatoes per hill, but a large number of large potatoes, few or no small ones.
2. Good quality. For culinary use, this means a large amount of starch, which makes the potato mealy when cooked.
3. Disease-resistance. Particularly in the Eastern United States, diseases are a serious hindrance to potato growing. There are no varieties that are disease-proof, but some are much more resistant than others.
4. Good keeping qualities. Potatoes must often be stored for a long time before they are used.
5. Good color of flesh and skin. In general, a yellow skin and white flesh are desired, but the South prefers a pink-skinned variety.
6. Skin of good texture. Buyers seem to think that a netted and slightly rough skin is to be preferred as indicating proper maturity and good quality.
7. Tubers of good shape. Flat-round or flat-oval potatoes are preferred to oval or cylindrical.
8. Shallow eyes, relatively few in number. This saves waste in peeling and lessens decay.
9. Proper length of season. Some varieties mature in seventy days after planting, others require 200. The grower must have a variety suited to the length of his local season.
10. Upright, vigorous plants. In general, a wide-spreading plant takes up more room and is more expensive to spray.
11. Thick-skinned leaves. These are not so easily penetrated by disease-spores.
12. No tendency to "second growth."
13. Trueness to type of variety grown.

With a definite knowledge of the kind of potato he wants, the grower will dig enough hills by hand to find some of his best, that conform to his ideal, and he will save the potatoes from these hills for his next planting. If he is going at it scientifically, and plants on a large scale, it will pay him to grow this seed for a few years and select the best each year for planting.[3] But most farmers will probably content themselves with picking out good hills for next year's crop. These may be chosen either by weighing the total number of potatoes produced, or by counting. If the season has been an average one, hills which contain six or more good tubers are saved for planting. In a poor year it may be necessary to use hills which contain only five; in a good year the standard may be raised to seven. There is no attempt at pedigree breeding by keeping the different strains separate. All hills meeting the established standard are thrown together and saved for seed. The next year these are planted; in the fall the process of selecting the best hills is repeated. This method will gradually eliminate the poor strains and raise the average yield of the crop very rapidly. The first year, perhaps only 5 or 10% of the hills will be found to have produced as many as six good tubers; the second year this percentage should be more than doubled; while after three years of selection, six marketable potatoes should be found in a fourth or a third of all the hills in the field.

[3] Full details of a method worked out by Dr. H. J. Webber, secretary of the Research Committee on plant breeding of the American Genetic Association, are given by Dr. Gilbert (pp. 63–69). This method is said to have been remarkably successful.

Zavitz, of the Ontario Experiment Station, selected the best hills of seven varieties of potatoes for a period of sixteen years. During the first four-year period their average yield was 120 bushels. During the three succeeding periods of four years each, as a result of selection, the average yields were increased to 216, 218 and 249 bushels. Within the sixteen-year period, the methods of culture were kept practically the same and the result is, therefore, to be attributed to selection.

But when single high-producing hills are saved for the next year's planting, one should make sure that they did not come from some highly fertilized or particularly favorable part of the field. Preferably they should be chosen from the poorer parts where their production has been high in spite of a bad environment. This will show that they really have good heredity: and it is potatoes of good heredity that must be depended on to put money in the grower's pocket.

For further details, the grower must consult Dr. Gilbert's book. It is difficult to think of any subject connected with potato-growing, which he has not covered. History, botany, climate and soils, fertilizers, planting and cultivation, insects and diseases, harvesting, marketing, and by-products, are all discussed, and the last chapter considers the important matter of profits. A review of genetic experiments on the potato brings together many results in a convenient form.

HISTORY OF THE POTATO

Considering how recently the potato was brought to the attention of the civilized world, it is remarkable that it should now be the greatest food crop, supplying about one-fourth of the entire diet of European countries. It was first discovered by the Spaniards in the neighborhood of Quito, Ecuador, where it was cultivated by the natives. The first notice is that of Pedro de León (1550) who mentions that the inhabitants of Peru lived largely on maize and "papas," the latter the Indian name of the potato which is still universally used in Latin America. The natives often dried their potatoes in the sun and made them into flour—a practice followed in Europe but little known in North America, although it should be widely used.

The vegetable may have been carried to Spain as early as 1535; thence it spread all over Europe, but only as a botanical curiosity. The Spaniards brought it from South to North America some time before 1585, since friends of Sir Walter Raleigh secured it in Virginia in 1586 and brought it to England. At the discovery of America, von Humboldt says, the plant was cultivated in parts of western South America from Chile to Colombia, but not in Mexico, and there is no record of its being found wild in North America. Many forms are found growing wild today in South America, but it is impossible to say that any of them is an originally wild form. The potato has, perhaps, been so long under cultivation that the wild prototype has ceased to exist.

Europeans long looked on the potato with disfavor, and its culinary use spread only as an emergency food in time of famine, although it had become quite widely used as a food for animals particularly in Germany. It is only in the last century it has become a staple on the dinner table. The number of varieties has become very large, but there are scarcely more than a half dozen types in the United States which possess real commercial importance. Experimenters will from time to time be able, perhaps, to produce something better than is now grown. But the task of the farmer is merely to pick out the best strains from the present varieties. This task he can easily achieve by selecting only the best hills for planting; and a little care in this selection, even if no new acreage is planted, ought eventually to double the value of a crop which is already worth half a billion dollars a year to the United States.

THE GLUTEN OF BREAD

Protoplasm the Physical Basis of Life—Distributed in Form of a Network Can Be Visualized by Study of Gluten in a Grain of Wheat

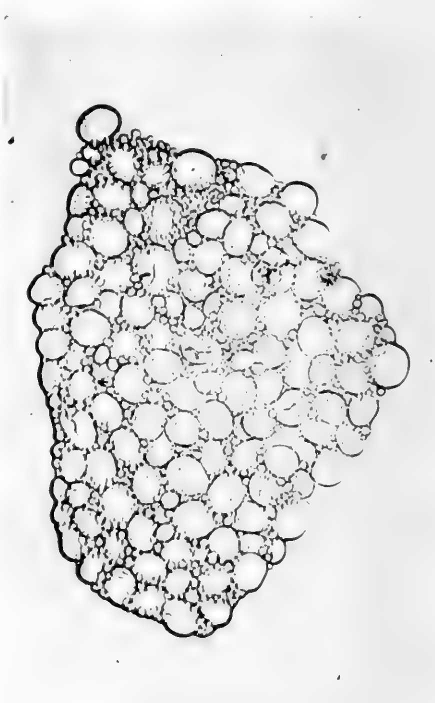
PROTOPLASM is much talked about and called the physical basis of life, but when the layman speaks of it, he often has no definite picture in his mind. He knows that it is said to be like an emulsion, that it contains carbon, hydrogen, oxygen, nitrogen, sulphur, and various salts, that it is so complex as to baffle any exhaustive analysis; and he thinks of it as a mysterious substance known to men of science, but quite outside his own world of experience.

This is not wholly correct. Most people, at least if they live in the country, have at some time chewed a few grains of wheat, spitting out the bran and swallowing the dissolved starch, until finally there was left on the tongue a little pellet of tough, elastic gluten. This gluten is one form of protoplasm.

Every living cell must contain protoplasm—otherwise there can be no life in it—and this protoplasm is arranged in the form of a network, as can be conveniently seen by study of a grain of wheat. The wheat kernel is not a single cell: it consists of the germ, or embryonic plant, and ten or twenty thousand minute flour-cells whose function is to supply nourishment to the embryo while it is sprouting. Flourcells and embryo are all enclosed in a fibrous protective covering, which, when removed by the miller, is bran.

By careful handling, a single one of these flour-cells can be taken out and placed under the microscope. At first sight it appears to consist merely of starch granules. The starch is soluble in water, and can be washed out by boiling. It then appears that the cell has a complicated structure; that it consists of a network of tough gluten, in the interstices of which the granules of starch were lodged. This structure is beautifully illustrated in a drawing from a preparation made by N. A. Cobb (Fig. 8.)

"Every flour-cell has all the common constituents of the living cell, and all are in a living state—each in its proper position, and reacting as living matter.



A FLOUR-CELL

A grain of wheat consists of the germ or embryonic plant and ten or twenty thousand flour-cells like the above, which are intended to supply nourishment to the embryo as it grows. The flour-cell appears at first to be merely a mass of starch granules of different sizes, but when these are washed out, a definite structure is revealed. Photomicrograph by Albert Mann, about 200 times actual size. (Fig. 7.)

There is the protoplasm with all its complexities, the nucleus with all its directive possibilities; there is the starch and the soluble portion together with

NETWORK OF PROTOPLASM IN A FLOUR-CELL

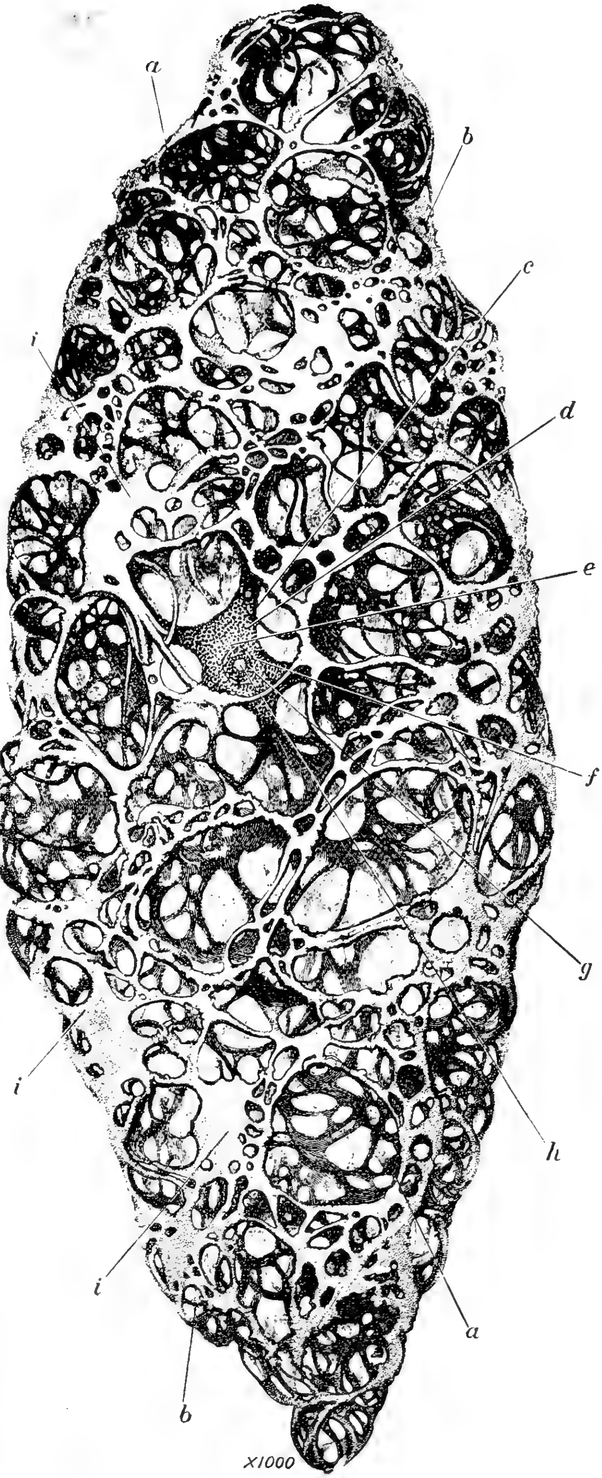
In a grain of wheat there are ten or twenty thousand flour-cells like the one shown herewith—magnified to 1,000 diameters. The wall of the cell has been removed and the starch washed out so that the complex and definite structure of the cell is revealed. Like all living cells, it consists of a network of protoplasm, that substance without which life cannot exist. In wheat, the protoplasmic network and the nucleus constitute the gluten. The details are as follows: *a*, *b*, the network in whose meshes large and small starch granules were held; *c*, the wall of the nucleus; *d*, the chromatin of the nucleus; *e*, a more or less colorless zone surrounding the true nucleus; *f*, wall of the nucleus; *g*, granular components of the nucleolus; *h*, vacuole of the nucleolus. The nucleus is very irregular in shape because of the pressure on it of the starch granules.

As protoplasm is a very complex substance, it would be a mistake to suppose that all protoplasm is comparable with the gluten in wheat. As a fact, the protoplasm of every species is different, and there are only a few grains in which the proteins are found in tough masses, as in the gluten of wheat.

Within a single species, the proteins have many different forms. The protoplasm in the wheat germ is not exactly the same as that in the starch cells. Indeed, so complicated is the subject that the grain of wheat has been very figuratively likened to a chemical laboratory, in various parts of which various compounds are being constantly made.

It seems probable that the gluten, like the starch, is used as nourishment by the germ of the wheat, when it starts to grow.

With the discovery that each species has its own characteristic protoplasm, it was also learned that the different proteins produce different effects in the nutrition of men. This greatly complicated the question of a suitable diet. It is not desirable to depend on the protoplasm of any one plant or animal species for human food, but to eat a wide range of proteins. This will insure that the body gets the compounds which are necessary to it. (Fig. 8.)



A SLICE OF WHITE BREAD

Magnified ten times to show how it is made up of bubbles of the sticky gluten intermingled with the cooked starch to form a sponge-like mass. The dark places in the photograph are air-spaces. One of the principal offices of the gluten is to hold the carbon dioxide gas which is formed in baking by the action of yeast and steam. It is this gas which makes the bread "rise." White flour such as is used in this bread is mostly starch and contains only 7 or 8% of gluten, the most valuable parts of wheat for the purpose of building the human body. Photograph by John Howard Paine. (Fig. 9.)

BREAD MADE OF WHOLE WHEAT

Ordinarily, the innermost layers of bran and the layers of starch cells adhering to them are removed together and, as "shorts," "middlings," etc., used as food for live-stock. Their rich content of protoplasm makes them a valuable food. Sometimes they are used for human food, when the entire wheat kernel is ground into flour. A slice of this whole wheat bread, ten times actual size, is shown above. It may contain twice as much protoplasm as does ordinary white bread. Photograph by John Howard Paine. (Fig. 10.)

a limited amount of water. We are accustomed to speak of the wheat seed as having a suspended vitality, but this is only a rough approximation to the truth. The fact is that its cells are living and have indeed accomplished only one-half of their allotted life. The other half is connected with the transference of their material to the embryo as needed. The seed, therefore, has its living activities, and, though these are not as rapid as those of the ordinary plant cell, it is impossible to point out any other essential difference. Their rate of life is retarded, not suspended, as we ordinarily say, for if the seed be kept dry it goes on living for a number of years, according to the kind of seed, and then dies."[1]

From this it is evident that flour, as it comes from the mill, is also alive. Most of the flour-cells will have been crushed, but some of them will pass through the rollers unbroken, thanks to their small size. Whether whole or crushed, they are alive. Wheat flour is living matter, just as much as is a raw egg or oyster, for some time after it is made, until it has ripened, as the millers say, or died, as a biologist would put it.[2]

Different wheats contain different amounts of protoplasm. The durum wheats, of which macaroni is made, are notably rich in this respect—so much so that they do not bake up well into bread, unless given special treatment.

It has been found that the flour-cells in the interior of the seed contain the smallest amount of protein or gluten (about 7%), while the amount increases in cells nearer the surface, until those just under the bran contain as much as 16 or 17%. Unfortunately, when ordinary white flour is milled, the richest gluten cells are thrown out with the bran and what is in many ways the most valuable part of the grain is thus eliminated. Hence the great superiority, as a body-building food for man, of war bread or any whole-wheat bread in which much if not all of the bran is included.

The Classical Example of Consanguineous Marriage

The Ptolemies, who ruled Egypt for several centuries, wanted to keep the throne in the family, and hence practiced a system of intermating which has long been the classical evidence that consanguineous marriage is not necessarily followed by immediate evil effects. The following fragment of the genealogy of Cleopatra VII (mistress of Julius Caesar and Marc Antony), is condensed from Weigall's Life and Times of Cleopatra (1914), and shows an amount of continued inbreeding that has never been surpassed in recorded history, and yet did not seem to produce any striking evil results. The ruler's consort is named, only when the two were related. The consanguineous marriages shown in this line of descent are by no means the only ones of the kind that took place in the family, many like them being found in collateral lines.

Ptolemy I
Ptolemy II
Ptolemy III m. Bernice II, his half-cousin.
Ptolemy IV m. Arsinoe III, his full sister.
Ptolemy V
Ptolemy VII m. Cleopatra II, his full sister.
Cleopatra III m. Ptolemy IX (bro. of VII), her uncle.
Ptolemy X m. Cleopatra IV, his full sister.
Bernice II m. Ptolemy XI (bro. of X), her uncle.
Ptolemy XII, d. without issue, succeeded by his uncle,
Ptolemy XIII
Cleopatra VII

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[1] From an address by Dr. Cobb at the Bakers' Institute, Milwaukee, 1908; printed in thirteenth biennial report of the Bureau of Labor and Industrial Statistics, Pt. v, Madison, Wis., 1908, pp. 735–747.

[2] Under favorable atmospheric conditions, it may live for six months or more. Formerly the millers hastened its death by controlling the temperature and moisture; now they electrocute it, thus "ripening" it without delay.

DEATH OF PHILIPPE DE VILMORIN

PHILIPPE LEVÊQUE DE VILMORIN, one of the most conspicuous figures in European genetics, died on June 30 at the age of forty-five, according to a cablegram received by President David Fairchild of the American Genetic Association. A reserve officer in the French Army, he was for a time attached to the Anglo-Indian Army in France as an interpreter, and later was a French Purchasing Agent in London. He had been ill in Southern France for some months, presumably as the result of overwork.

Although identified with plant-breeding, M. de Vilmorin also carried on dog-breeding experiments for many years. His closest scientific affiliations were with William Bateson of England, whom he regarded as his Mentor, and J. P. Lotsy, the Dutch botanist. He was secretary of the last International Conference on Genetics, and a life member of the American Genetic Association. He had made numerous trips to America, had many friends here, and published a report for the French Government on agriculture at the St. Louis Exposition. His published work is considerable in size and value, but his greatest contribution to genetics was, perhaps, his personal influence, which can only be understood by the help of a knowledge of his family history.

As early as 1727 there was in Paris a seed store "*Au coque de la bonne foy*," kept by Pierre Geoffroy, whose daughter and heiress married Pierre d'Andrieux, a botanist. Their daughter in turn married, in 1774, Philippe-Victoire Levêque de Vilmorin, a young botanist belonging to a Lorraine family which was identified with war and agriculture. Thus was founded the business still known as Vilmorin-Andrieux and Company, one of the most celebrated seed-growing and seed-selling establishments in the world.

PRODUCTION OF THE SUGAR-BEET

The business was handed on from father to son, and the family grew in size and importance as did the business, the two being identified in a remarkable way. Many de Vilmorins have, in every generation, been identified with the progress of scientific agriculture in France, but none is so well known as Louis de Vilmorin (1816–1860), the producer of the sugar-beet. Of the three great contributors to the theory of genetics, in nineteenth-century France, de Vilmorin alone did work of great practical importance. Jourdan's study of the nature of species and Naudin's hybridization experiments which so nearly revealed the laws of Mendel, have had great influence; but de Vilmorin, the third of the trio, not only invented the centgener method of breeding, but revolutionized the sugar industry. His achievement is one of the stock examples in textbooks of plant-breeding. Starting with a sweet yellow beet from Germany, he analyzed many roots, selected those which had the highest sugar content (from 10% to 12%), and planted separately the seeds borne on each root. From the rows which produced the best yield, he again selected the roots with highest sugar content, and so continued until he had raised the average yield to about 18%, a figure which has hardly been surpassed since his time. By growing this strain of beets, continental Europe was able to make sugar in competition with the cane-growing countries of the tropics.

Louis de Vilmorin was succeeded as head of the family and of the business by his son Henri, who made many contributions to the study of heredity, his work on wheat and potatoes being best known. He died in 1899,* when Philippe de Vilmorin, whose death has just been announced, succeeded him. By this time the large family had become one of the most important in France, scientifically, financially, and socially, and Philippe's position as head of it carried a prestige which can hardly be understood in the United States. The business had also reached

large proportions, seeds being grown in many parts of the world. A great farm at Verrières-le-Buisson, near Paris, has been used since 1815 for seed-testing experiments, and much experimental breeding has been done here in recent years by Hagedoorn, Meunissier, Mottet, and other geneticists in the employ of the firm. Adjoining it is the estate where Philippe spent most of his time engaged in his own genetic experiments, the active direction of the business having been taken over by his brother-in-law, Comte d'Etienne.

Another very important figure in French agriculture is his uncle Maurice, who, at Les Barres, has one of the greatest collections of shrubs and trees in Europe, and who has long been president of the Academie d'Agriculture. He published a book on "Horticulture in the United States" in 1894, and the monumental "Fruticetum Vilmorinianum," in 1905.

A letter written to President Fairchild by Maurice de Vilmorin on June 17 reveals how the trained horticulturists of France have been drafted into military service to such an extent as to endanger the existence of the remarkable collections created at great expense by the Vilmorins and others.

"In fact," M. de Vilmorin says, "I am so destitute of workmen that I scarcely am in a position to maintain the plants of my numerous collections. I can do nothing more until the circumstances are fortunately changed for a better standing."

Henri, a younger brother of Philippe, has made several visits to the United States, the last just prior to the war, and has many friends here.

THE VILMORINS IN THE WAR

The de Vilmorin family has lived up to its military traditions in the war, Henri being an officer in the navy and the other four brothers having commissions in the army. Philippe's work as interpreter has been mentioned. Vincent returned from China to join his company and is understood now to be with the French expedition at Salonika. Louis has commanded a section of automobile guns and won two medals and mention in dispatches for his gallant conduct. Jean was hit by four bullets at Peronne almost as soon as the war began, was captured by the Germans but exchanged, recovered, and is now believed to be in Macedonia with his regiment of cuirassiers.

One of Philippe de Vilmorin's great services to genetics was the organization of the Fourth International Conference on Genetics, held in Paris, September 18–23, 1911. This conference was made possible largely by the de Vilmorin family, which furnished most of the necessary funds. Philippe was secretary, and on him fell a large share of the expense as well as work connected with meetings, entertainments, and publications. He issued for distribution to the members a pamphlet giving a brief history and bibliography of genetics, had bronze medals made for the foreign delegates, and edited the large volume of proceedings, the cost of publishing which was defrayed by him personally.

The most important of his published work in genetics has dealt with wheat. The breadth of his interest and information is shown by a publication on the beet-sugar industry of the United States, another on the culture of ginseng in Korea and Manchuria, and another on the tobaccos of commerce. He took a keen interest in flower gardening, and was responsible for three important publications of the firm: "Les Fleurs de Pleine Terre," "Le Manuel de Floriculture," and the "Hortus Vilmorinianus." The first two are standard works on flower gardening in Europe, while the third is a large and valuable report on the appearance and behavior of little known plants which the firm has tested at its various gardens.

While the influence of French workers in genetics has been large, the number of men actually engaged in this science has always been relatively small. Science can ill afford the loss of a man like Philippe de Vilmorin, who combined great wealth, high social position, and leadership in an immense business organization, with a profound enthusiasm for genetics, and who used all his possessions so freely to advance the science to which he had devoted his life.

A BUD VARIATION OF PITTOSPORUM

A. D. Shamel, *Riverside, California*

ONE of the most attractive and ornamental hedge plants grown in the vicinity of the writer's home at Riverside, Cal., is *Pittosporum tobira* var. *variegatum*, Ait. In addition to its use for hedges, it is occasionally found planted in gardens and lawns or along the roadsides as individual shrubs or trees and in tubs for house plants. Many visitors to this section of southern California from New England, and other places where the variegated pittosporum is a favorite house plant, remark upon the size and beauty of the plants when grown in the open in this sub-tropical climate. The plants frequently grow to 6 or 8 feet in height in this locality. The fully developed leaves are, on the average, about three inches long and about one and one-half inches wide. The leaves are entire and permanent, obovate in shape, and usually very obtuse. They narrow to a short petiole. The leaves are arranged in apparent whorls. The glabrous mature leaves are thick and have a leathery texture. Their color is usually light green and slightly paler beneath while the margins are revolute and are white or silver in color. The white areas are of irregular shape and size. The mass effect of the white margined leaves is highly ornamental and the individual shrubs make a beautiful showing during the entire year in this reigon.

The plants usually bloom here in the Spring and were in full bloom in 1917 during the last of April and early May. The flowers are usually light yellow in color and are arranged in terminal umbels. The calyx is made up of five sepals and the corolla of five petals. The tips of the petals are recurved. There is usually one style and one stigma. The capsules are very hairy, ovate, and the valves are made up of a resinous pulp. The flowers from a distance somewhat resemble orange blossoms in appearance and are rather fragrant. This variety rarely sets seeds here, if at all, and is usually, if not always, propagated from cuttings of partly ripened wood.

The variegated pittosporum is frequently subject to striking bud variations, as shown in Fig. 11. From this standpoint it is of very great interest to the writer. From the observation of many individual plants I have failed to find one, as yet, which does not show one or more branches of the green-leaved original. Most plants examined have been found to possess several such branches. In one case, for instance, the plant is almost equally divided, one-half being variegated, while the other half is not variegated. Again, on a neighboring plant one main lower branch is not-variegated while the remainder is almost wholly variegated. Further, other variegated plants show several small not variegated or green branches.

These observations led to a study of several *Pittosporum tobira* plants where frequent instances of variegated branch sports were found. The degree of variegation in these bud variations was marked, ranging all the way from branches bearing pure white, or almost pure white leaves, as shown in Fig. 11, to those having leaves with only very narrow and small white areas. Typical cases of variegated variations were found similar in appearance to the several strains of the variegated variety planted in the vicinity of Riverside.

The occurrence of the variegated bud variations of *Pittosporum tobira* and the fact that this plant is propagated by cuttings, offers a logical explanation of the origin of the variegated strains. Furthermore, upon inquiry amongst local propagators, it was found that the variegated strains in this region have been established by the propagation of the beautiful variegated bud variations of green-leaved *Pittosporum tobira* plants. It was also found that propagators have isolated not-variegated *Pittosporum tobira* plants by propagating

BUD VARIATIONS OF PITTOSPORUM

Green leaves are normal in the widely grown ornamental shrub, *Pittosporum tobira*, but variegations frequently appear and are propagated by cuttings. The branches shown above are from a single plant. The lowermost twig at the left is absolutely white except for one small section of green. The limb at the right shows that green branches and variegated branches may arise at almost the same point. Valuable commercial varieties of ornamental plants are secured by propagating bud variations of this sort. (Fig. 11.)

the green-leaved bud variations of the variegated plants.

The shape of the leaves of the not-variegated variety is more lanceolate than that of the leaves of the variegated variety. The green color of the leaves of the not-variegated plants is usually of a deeper shade than that of the variegated leaves. Hall[1] notes that this variety is said to withstand violent saline winds better than most other shrubs.

This presentation of the facts concerning the origin of the useful and beautiful variegated Pittosporum is for the purpose of calling attention to the possibilities of the study and utilization of bud variations for the propagation of valuable commercial varieties of ornamental plants.

[1] Bailey's Cyclopedia of Horticulture, p. 2654.

INHERITANCE OF WHITE FORELOCK

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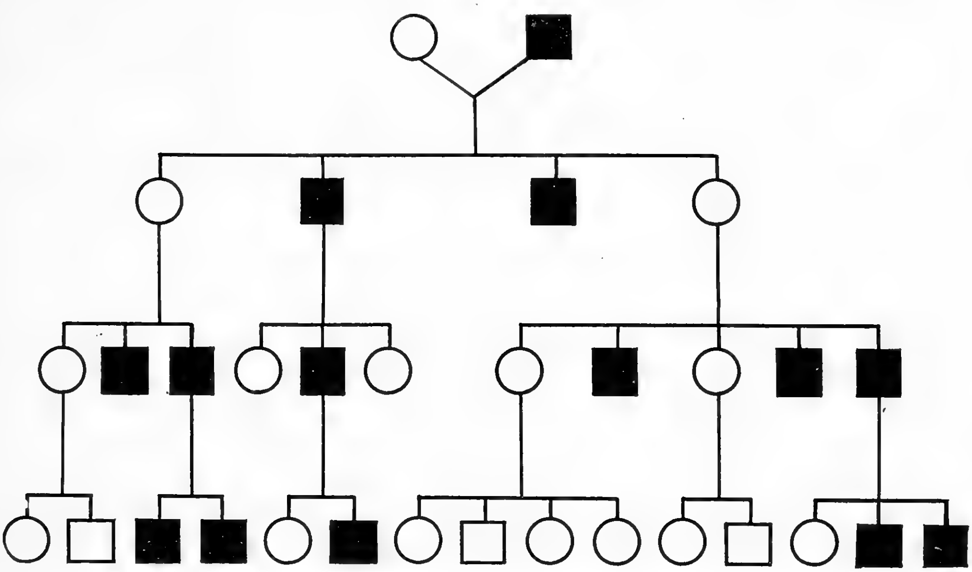
THERE are a number of cases on record in which a lock of white hair has been traced through several generations. In general the white lock behaves as a typical dominant character, manifested by males and females alike.[1] In a family which has come to our notice, the white lock has been found to occur only in the males, although the females in the family, at least some of them, are capable of transmitting this peculiarity to their sons.

The lock occurs in the center of the fore part of the scalp. The region affected is about the size of a half dollar, and the hairs making the lock are slightly larger than those surrounding it and which may be of any general color. The lock is not evident in children, but makes itself manifest about the period of puberty. In all cases in this family the sons of affected males are also affected, although unaffected males might be expected to occur also. This distribution is in all probability due to chance. The females who are heterozygous do not manifest the white lock, but all of the daughters of the affected males have transmitted the character to their sons. Some of the females have no affected offspring, either because they are nulliplex or because their sons happened to escape.



PEDIGREE OF FAMILY WITH WHITE FORELOCK

Squares denote males and circles females; affected individuals are indicated by black squares. Not once in the family history has the forelock appeared in a female; the probability that this is not due to mere chance is very great. Other families have been studied, in which this white spotting factor affected both sexes alike. (Fig. 12.)

[1] The pedigree of one such family, extending over six generations, was published by Newton Miller in the Journal of Heredity, VI, pp. 165–169, 1915.

The character behaves apparently as a dominant in the males and as a recessive in females. Its transmission, therefore, is quite parallel to the inheritance of horns in the crossing of a breed of sheep in which only the males have horns with a breed in which both sexes are hornless. Owing, probably, to some hormone peculiar to the male sex, the white lock is manifest in the heterozygous males.

The development of hair in human beings is markedly influenced by sex, both as to its vigor of growth and extent of distribution. It is a noteworthy fact that baldness in man, according to recent studies of Miss Osborn,[2] behaves as a dominant in males and as a recessive in females. The limitation of the white lock to the males in the family which we have studied, may have some underlying association with the transmission of baldness. It is a curious fact, however, that it should be associated with the male sex in one family, while its transmission is independent of sex in others. In one pedigree described in Pearson, Nettleship and Usher's *Monograph on Albinism in Man* (Part 1, p. 265), a white occipital lock occurred only in males, but was transmitted through females. In each case the white lock skipped one generation, and in no case was the son of an affected male known to have exhibited the character. There were, therefore, a number of unaffected males in the family, but the whole pedigree is nevertheless consistent with the view that the white lock is dominant only in the male sex.

A PARALLEL AMONG SHEEP

There is no evident reason why a white lock should be associated with a particular sex in some families and not in others. The character is not sex-linked in the sense in which this term is applied to night-blindness and haemophilia in man, or to various characters of Drosophila. However, a parallel phenomenon is present among sheep, in which only the males of some breeds are horned, while both sexes have horns in other breeds.

Eugenics and Military Exemptions

The worst effect that a war has on any nation is to lower the average of its racial stock. It should be the object of every nation, therefore, to fight its wars with a minimum loss of its best stocks.

The draft act of the United States exempts the following: "persons engaged in industries, including agriculture, found to be necessary to the military establishment or the effective operation of the military forces or *the maintenance of national interests* during the emergency."

The nation will be justified in calling up the talent that is unreplaceable in various activities after it has exhausted the number of replaceable men who are equally good as soldiers, but not before. In addition, therefore, to the men who are necessary for the production of war supplies, there should also be exemption of those men whose trained abilities make them valuable to the national interests. These should not be drafted as long as there is plenty of material possessing physique, courage, and the fighting spirit. If called into military service, it is probable that these men will be used as mere privates, not as officers; and to place ability of a high order in the ranks in this way is unwisely jeopardizing the national interests. This is true not only from the standpoint of the present generation but still more from that of future generations.

Certainly with conscription within the narrow range of twenty-one to thirty, and not all men of this age used, it is indefensible to take men of extraordinary ability in any direction not utilizable in the Army, when the work can be done by men whose loss would be less felt by the nation.

ROSWELL H. JOHNSON,
University of Pittsburgh.

[2] JOURNAL OF HEREDITY, VII, pp. 347–355, 1916.

ADULT CHARACTERS IN SUNFLOWER SEEDLINGS

T. D. A. Cockerell, *University of Colorado*

THE study of seedlings is obviously of practical importance. We want to be able to recognize the young plants coming up; to know the different kinds of weeds, in order to deal with them at the earliest possible moment. For such purposes, it is sufficient to be able to distinguish the genera and species in the seedling stage, and we are not particularly concerned with the varieties. When raising new varieties of sunflowers, however, we have had occasion to note the variation in the seedlings of the species *Helianthus annuus*, and to consider its meaning and importance. At the outset, we noticed that the *coronatus* variety, with chestnut red on the rays, could nearly always be distinguished as a seedling by the purple tint of the stalk and cotyledons. The stalk, or more properly hypocotyl, is usually deep purple, while the cotyledons show more or less of the same color. This enables the grower to pick out his red sunflowers almost as soon as they are up, and reject those which do not possess the desired character. Unfortunately the distinction is not valid for the vinous (wine-red) forms; why, we do not at present know. More recently, we have found various modifications of the cotyledons, showing structural as well as color differences. Four of these are now figured, and may be described thus:

Fig. A, A.[1] April 21, 1916. Seedling of var. *coronatus*, with one cotyledon strongly bi-lobed. At the angle between the lobes, on the under side (Fig. A[1]) is a sort of little pocket, surrounded by a swelling. The hypocotyl, margins of cotyledons, and a median band on the bi-lobed cotyledon, are dark purple. The small first leaves are hairy, and minutely speckled with purple.

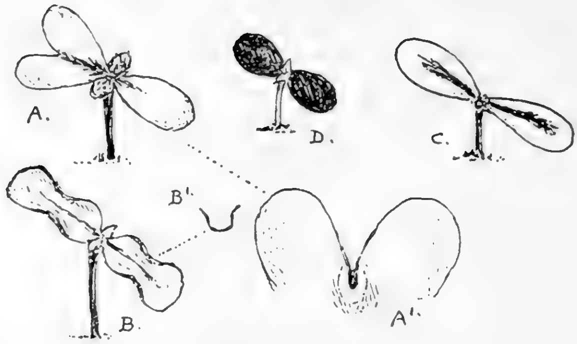
Fig. B, B.[1] April 23, 1916. Seedlings from Leonard Sutton of England, from vinous plants with quilled rays. About half these seedlings show an entirely new variation of the cotyledons, which appear fiddle-shaped, with the middle pinched in. They are not really narrower in the middle, but the margins are elevated (Fig. B[1], cross-section), giving the appearance shown. There is a variable dark purple median stripe, sometimes absent. On July 23 the plants were in flower, and were vinous bi-color, mostly rather pale, with normal rays.

Fig. C. April 11, 1916. Seedling of var. *coronatus*. The cotyledons have very conspicuous dark purple bands running down the middle, not reaching the apex. The margins of the bands are fimbriate toward the apex.

Fig. D. April 19, 1916. Grown in house. Seedlings of var. *vinosus* x (*annuus coronatus* x *cucumerifolius*); that is to say, one of the parents is a hybrid between *H. annuus* and *cucumerifolius*. Cotyledons above *entirely* dark plum color, small; first leaves light green, contrasting. April 22. Four plants with same history now up, two dark, two with green cotyledons. These all set out in garden, and on May 6 the cotyledons had grown considerably, and were now *green*, the purple having disappeared. First leaves light green.

We may consider these variations from two points of view. Are they connected with adult characters? Are they of any functional significance?

As to the latter question, it is not to be supposed that the modifications of shape have any functional importance. With regard to the color, the matter is not quite so clear, but the green seedlings in the lot described under D grew exactly as well and in the same manner as the purple ones. It is not possible to find any physiological advantage in the dark color, apparently. Indeed, Miss Wheldale, in her important new work on "The Anthocyanin Pigments of Plants," after devoting a chapter to the physiological significance of antho-



VARIATIONS IN SUNFLOWER SEEDLINGS (Fig. 13.)

cyanins, is obliged to conclude: "The pigment is produced, of necessity, in tissues where the conditions are such that the chemical reactions leading to anthocyanin formation are bound to take place. For the time being we may safely say that it has not been satisfactorily determined in any one case whether its development is either an advantage or a disadvantage to the plant."

As regards the other matter, the characters observed are evidently inherited like other characters, and appear to segregate in a mendelian manner, as shown by the occurrence of both normal and variant types, without intermediates, in two cultures. In Holland, deVries had a race of sunflowers producing syncotylous seedlings, with the two cotyledons united. He found that the character was inherited, though he could not isolate a pure race. Thus the peculiarities of these seedlings must be due to germinal factors, or determiners, which cannot be confined to the seedling stage; yet the manifestation of their effects may be limited to that stage. Just as in insects (moths and beetles, for example) the larvae may show marked differences, while the adults are *apparently* alike; so in plants the seedling stage *may* be the only one in which the existence of particular hereditary factors is revealed. On the other hand, the seedling characters *may* be obviously correlated with adult ones, and it is not impossible that, sometimes, the failure to observe any correlation is due to a lack of similarity between the effects produced at different ages.

A Book for Family History

OURSELVES, A personal and family history register for preserving records of a private and personal nature, for one married couple and their children. By John Madison Taylor, A. B., M.D: Quarto, price $5.00 net. Philadelphia: F. A. Davis Company, 1917.

There has long been a need for a book in which families could record their pedigree and family traits, and Dr. Taylor's large volume can be recommended for this purpose. It has ample space for genealogical charts and data, and provides blanks and suggestions for making a complete record of the development of children. It is free from over-elaboration of detail, although amply full, and its simplicity ought to appeal to many parents. The value of keeping such a family record as this is recognized by every eugenist, but it is probable that few have put their convictions into practice. With Dr. Taylor's "family account book" available, one of the principal excuses for not keeping a proper family record is removed.

ANTS AND APHIDS

The Remarkable Relations Existing between Them—Aphids Act as "Cows" for the Ants, in Return for Care and Protection—A Baffling Problem of Heredity

OF ALMOST fifteen hundred insects, spiders and crustaceans who have unusual amicable relations with the ants or who live in the same nest with them, none is of more interest than the common aphis. Mealy bugs, tree hoppers, lantern flies, and certain species of caterpillars also live in the same relationship, but the relationship in the case of the aphis is most apparent.

Aphids live on practically every form of plant life and on every part of the plant, including the roots, stems and leaves. They pierce the integument of the plant with their hard and sharp mouth-parts and suck the juices, which consist of water, cane sugar, invert sugar and possibly a slight amount of albuminoid matter.

The juices pass through the alimentary canal of the insect, where a slight portion is absorbed, the rest undergoing a chemical change wherein the cane sugar is turned to invert sugar or glucose. The changed plant juices are then voided through the anal opening in the form of colorless droplets.

Réaumur in 1737 and Leche in 1765 were the first to ascertain the true origin of these droplets, which often collect on the leaves in vast quantities. The linden aphis was found by Büsgen (1891) to void nineteen drops in the course of twenty-four hours, while the maple aphis excreted as many as forty-eight drops in the same time. This is a surprisingly large quantity considering the small size of the insects.

This voiding of "honey dew" furishes the ant with a never failing supply of nutritious and, to it, delightful food. Some species merely lick the leaves on which the dew has dropped, others do not appear to hunt for the liquid at all, but most ants learn to stroke the aphids in order to make them void the sought-for food, just as a cow is induced by the hired man to "give down" milk. Thus the honey dew can be imbibed directly. Some ants are found to live exclusively in this manner.

THE ANTS' PROCEDURE

When desiring food, the ant caresses the abdomen of the aphis with first one and then the other antenna. The aphis immediately voids a droplet of honey dew, which is at once seized by the ant, who goes on to another aphis and repeats the operation. If the second aphis fails to respond the ant perceives that nothing is to be expected, since the aphis has no honey dew left at that moment, and goes on to another. Five or six such repasts are sufficient to satiate the ant, and she returns to the nest. If the aphis does not receive sufficient attention from the ants, it voids the droplet without waiting to be stroked. In this case, the droplet is ejected forcibly some distance, which is not the case when it is given directly to the ants after stimulus.

The ants sometimes exhaust the aphis' supply of honey dew and then have to wait until the aphis can pump up a fresh supply from the plant. The aphis is very generous, however, and will often yield several droplets in succession to different ants.

Some aphids have on the sixth abdominal segment a pair of tubules, and it was the idea for a long time that these were the source of the honey dew. This has now been proved false. The excretion of the tubules is yellow and sticky and is used as a protection against the lady-bird beetle, the so-called aphis-lion, and other hereditary enemies of the aphis. When the enemy attempts to seize the aphis, the latter immediately excretes the defensive liquid from the tubules, smearing the head and thorax of the beetle with it. This usually frightens, blinds or dis-

ANTS "MILKING" THEIR APHIDS

The aphids live on the juices of plants, and excrete drops of honey dew, a weak syrup. The ants protect them from enemies, build nests for them, and care for their eggs and young. When an ant wants a meal, he goes to an aphis and strokes it, whereupon the aphis emits a drop of honey dew, which the ant drinks up. Half a dozen aphids will thus supply the ant with a square meal. Photograph by Brown and Dawson. (Fig. 14.)

concerts the attacking party to such an extent that the aphis has a chance to make its escape.

The manna of Biblical tradition is now known to be the honey dew of a species of coccid, or mealy bug (*Gossyparia mannifera*), which lives on the tamarisk. It is still eaten by the Arabs, who call it "man."

HISTORY TOLD IN AMBER

It is found that the same relations existed between the ants and aphids in prehistoric times as now. Blocks of amber which are perhaps 2,000,000 years old sometimes contain the ant and aphis together, and with other evidences make it sure that then as now, the ant depended largely on the aphis for food. At present, seventeen species, including nine genera of aphids, have been observed being "milked" by ants.

Since the ants derive an easily obtained and close at hand supply of nutritious food from the aphids, it is but fair that they should render equal if not similar services to their allies. And that the relationship is mutualistic is made evident in many ways.

The ants protect the aphids in every way possible; they fight their enemies; they build tents to protect them; they carry them away to a place of safety in times of danger; they take the eggs to their own nest for the winter, see that they receive careful attention and are hatched at the proper time; place the newly hatched food purveyors where they can get an abundance of good succulent leaves and take them back to the nest in case of sudden cold weather, and at all times see that nothing is lacking for the comfort of their charges.

The aphids never try to escape, but on the contrary the females, when they desire to lay their eggs, often wait until found by ants who clip their wings (their exact reason for doing this being uncertain), and carry them into underground chambers, where the eggs are laid by the aphis and taken in charge by the ants.

The ants always stroke the aphids in the same peculiar manner and know just where to expect the liquid. The unusual care which the aphids are given often makes it possible for them to produce as many as sixteen generations during a summer, ten of which may be under the care of the ants simultaneously.

How the ants have come to handle the aphids in this manner has long been a baffling problem. Presumably the behavior is instinctive, but how did it arise? It has often been suggested that it is the result of habit which becomes hereditary—that is, an example of the inheritance of acquired characters. But most of the ants which show this specialized behavior are workers, sexually imperfect females who never leave any offspring. It is, therefore, quite impossible that they should transmit their training to offspring which they do not have. On the whole, no satisfactory explanation has been suggested to account for the origin and inheritance of the ants' habits.

New Egg Records in New South Wales

Egg-laying records are improving each year in the New South Wales competitions, the fifteenth of which closed this spring. A pen of six White Leghorns set a new mark by laying 2,647 eggs in two years, of which 1,231 were laid in the second year. The best individual record of a hen was 312 eggs in 365 days by a Black Orpington. This is much less significant, for the progress of the poultry industry, than the averages. There were 420 pullets of all breeds, which laid an average of 206 eggs each, in their first year. This achievement was largely due to the excellent care the birds received, but fundamentally to the fact that they came from selected stock. It shows that the egg-production of a country which has advanced far, by present standards, might yet be doubled if the most scientific methods were employed.

FOR THE GIFTED CHILD

Public Schools Are Beginning to Realize the Need of Special Provision for Pupils Who Are Above the Average—Few Make Any Real Study of the Capacities of the Unusual Boy or Girl

HOPE for the eugenic advancement of the race lies in those members of it who are inherently superior, and eugenists are, therefore, anxious that every gifted child shall be recognized and have a chance to develop to the utmost.

For some years retarded and defective children have principally occupied the interest of educational reformers, and much has been done to benefit them—almost too much, in fact, for often feebleminded children have been painfully nursed up to adult age and have founded families, also often mentally defective; while the superior child has had to support his weaker brothers and sisters, and his chance to establish a family which would have been of more than usual value to society, has thereby been limited. A large mass of literature has been published in regard to the special care and education to be afforded the mentally unfit, while very little has been done to give appropriate opportunities to those with exceptional ability.

Now, however, educators are beginning to realize that while the defective needs a special chance if he is to hold a place in the world, a chance offered the mentally superior will enable him to advance far beyond the average sphere of intelligence and usefulness. The same time and money spent in raising the mentality of the defective will produce a much larger comparative increase in the superior child.

A questionaire was recently sent by Dr. Elizabeth Woods[1] to school superintendents throughout the United States asking what provision they make for exceptionally gifted children.

Of the 549 cities answering, 288 are making some provision for the mentally superior children, generally in the form of an elastic promotion, to be made when the child is able to take up the advanced work. In addition to this, 167 cities which stated they made no provision for the advanced pupils were found to be using some elastic promotion system, whereby the mentally superior are really accorded a chance. Further, eighty-three which neglected to answer the question were found to be using a similar system.

Of the 167 superintendents who reported no such provision in their system, 67%, or 111, were emphatic in stating that there was urgent need for it.

VARIOUS SYSTEMS USED

Various systems have been adopted in an effort to assist the unusually bright child in acquiring all the knowledge he can assimilate. Many cities report special classes for their gifted pupils; some have summer classes; others divide up the pupils in the grade, without segregation. The subjects taught are usually those of the regular curriculum, but often election of language, science or business courses is allowed.

In some classes, the mentally bright are allowed to do more intensive work than the average student. Some segregated classes contain both backward and bright students, and the teacher's time is given to helping the students individually. Often it is made possible for students to pass the last three years' work in two years.

With but one exception in all the cases reported, the only special training required of teachers is unusually successful teaching experience. In some instances,

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[1] Woods, Elizabeth L. Provision for the Gifted Child. *Educational Administration and Supervision*, pp. 139–149, March, 1917. Dr. Woods was formerly in the department of psychology at Vassar College, but is now psychologist of the Pasadena (Cal.) city schools.

Normal School students assist in the personal help of the pupils. Some cities have one or more unassigned teachers, who go where their efforts are expected to prove most helpful.

Only eighteen cities make use of psychological tests in the selection of pupils for special training. Most of the students are selected simply on their school records, sometimes with the recommendation of the principal or superintendent. Thus, most selections are made on what the pupil has done with no special incentive to unusually good work, rather than on what he could do under more avorable conditions.

The psychological tests used include the Binet-Simon, Healy, Yerkes Point Scale, Woodworth-Wells, Whipple, Thorndike, Courtis, Ayres, Stone, University of Nebraska and some others. Many of these tests are educational rather than psychological, and except in one city they are administered by the principal or superintendent; although many cities employ trained psychologists to make special tests of defectives.

SUMMARY

To sum up the results arrived at, every city in the United States of over 8,000 population was reached; 549 out of 766 cities answered, or more than 71%; 402 or 73% have elastic promotion systems or other aids for the exceptionally bright children; 31% or 124 of these cities consider their present provision entirely inadequate.

Of those reporting, 174 or 31% have made some provision other than elastic promotions for the atypic child; 45 cities have classes for gifted children only; 77 cities have classes including both gifted and other "irregular" children; 36 cities have divided their regular classes according to mental ability; 16 cities have teachers whose entire time is given up to the personal training of either defective or superior pupils.

Less than 0.5% (3) of the superintendents answering the questionaire disapproved of the separation of the mentally superior; more than 24% were emphatically in favor of it, while many others who made no definite statement, must approve of it in view of the work they are doing.

As yet there is little attempt made to determine the special gifts o the unusually bright students—they continue the work of the regular grades, perhaps more intensified. A few schools permit the election of art, science, language or business by bright students of the higher grades. But sentiment appears to be growing more and more in favor of developing the child according to his particular aptitudes.

The change in the attitude of educators is evident. Soon, it is to be hoped, the principal attention will be centered no longer on the inferior, who can rarely be brought up to par, but upon the superior child, who with additional opportunities can develop into a far greater sphere of usefulness to society than if forced to take the same mental foods and stimulants as the dull or even the normal.

Eventually every well-equipped school system will provide expert psychologists who will diagnose and classify the students and will recommend suitable training and opportunities for the mentally superior. Then will the rate of advancement be for each student that which he individually is capable of sustaining. Then will the children above the average ability have ample chance to satisfy their thirst for knowledge, and children with special aptitudes or decided bents in particular directions will not be denied, as heretofore, an opportunity to make the most of what they have in them.

THE FIREFLY'S LIGHT

A Remarkable Structure that Seems in Some Cases to be of Little Value to Its Possessor—Possibly a By-product of Evolution—Serves in Many Cases as a Signal between the Sexes

FEW insects possess a more remarkable mechanism than the lighting apparatus of the firefly. It might be supposed that the evolution of such a mechanism would be of life-and-death value to its possessor. But it is difficult to see that it has such a value to the firefly. Its existence is possibly more or less an accident of evolution; but now that it is here, the firefly makes use of it, at least in some species, to find its mate.

The fireflies, which are in reality not flies but beetles, are found through the eastern and southern part of the United States almost any warm summer evening. There are two principal forms, which nearly always occur together; *Photinus pyralis* and *Photuris pensylvannica*, both members of the family Lampyridae. There are several other more insignificant species, which are so like these two as to require no separate description.

Photuris is strong and hardy, carnivorous, eating dead comrades or enemies with no discrimination, and generally flies at some altitude, especially among the tops of tall trees, flashing only occasionally, and sometimes moving several rods before again emitting its light. For some reason, males are much more infrequently taken than females, and captures which have been made have been found to average but one male for every fifteen females. The light-emitting organs are almost identical in the sexes.

Photinus is the more plentiful, and flies nearer the ground, flashing frequently. It is easily injured, and being so delicate is hard to keep in captivity, while Photuris will live well indefinitely if provided with a little sod. The male Photinus has much larger photogenic organs than the female, and hence the sexes are easily distinguished. The most characteristic flash of Photinus consists of a long fulmination of yellow light.

The photogenic organs of Photinus are the more complicated of the two species. Two small roundish spots appear on the next to the last abdominal segment in both sexes, these spots giving off a greenish light. In the male, the second and third posterior segments are also composed of photogenic cells, while in the female, an oval splotch on the third segment emits light, the rest of the segment not having this power.

The light emitted from the two small round spots in each sex is distinctly greener than that from other segments of the abdomen, but the cause of this is not clearly understood. It seems possible that the color depends upon the intensity of the light, but experiments have shown that often the green light is the brighter of the two, still retaining its greenish color. The color of the light seems to be useful as a distinguishing mark of the different species, no two emitting an identical shade.

It must be remembered that the light of such a beetle might and probably does have an entirely different effect on the compound eye of insects than it does on the simple eye of man. In all study of the light of the Lampyridae, this must be taken into consideration.

USE OF THE LIGHT

Many suggestions have been made as to possible or probable uses to which this light-emitting power is put by the

[1] The tropical fireflies belong to another family, the Elateridae or click-beetles. *Pyrophorus noctilucus* is the principal species. Its glow is continuous, not intermittent.

THE UNDERSIDE OF A FIREFLY, GREATLY MAGNIFIED

The light of the firefly comes from the two yellow segments near the tip of its abdomen, as everyone knows who has examined such an insect at night under a hand lens. The light-making apparatus of the male (shown above) is larger than that of the female. Fireflies lay their eggs just under the surface of the soil, and the carnivorous larvae hatch out in a few weeks. They hibernate under stones, spend three weeks in a pupal stage, and then emerge as adult fireflies. The light-producing tissue can sometimes be detected even in the egg; it is supposed to be a modification of fat tissue. Photograph, twelve times natural size, by John Howard Paine. (Fig. 15)

insect. The light might serve to attract prey; it might illuminate the path of the insect; its prey might be blinded by the brilliant flash, and thus its escape be prevented; enemies might be blinded similarly, so that they would be unable to attack the torch bearer successfully; some think it may serve only as an adornment; but the last and most plausible view of the matter is that it serves as a signal between the male and female of the same species.

"At night the males leave their concealment and fly about. A little later the females ascend to the tops of blades of grass and remain there without glowing. A male passes by and flashes his light; the female flashes back. Instantly he turns in his course to the spot whence the signal came and alights. He signals again. She replies. He ascends the blade, and if he cannot find her, he signals again and she responds. The signals continue until the female is found, and the drama of sex is finished.

"Mast has recently shown that the female firefly does more than simply respond to the signal of the male. If a male flies above and to the right of the female, she bends her abdomen so that its ventral surface is turned upward and to the right. If the male is above and to the left, the light is turned in this direction. If the male is directly above, the abdomen of the female is twisted almost upward. But if the male is below her, she emits her light without turning her body."

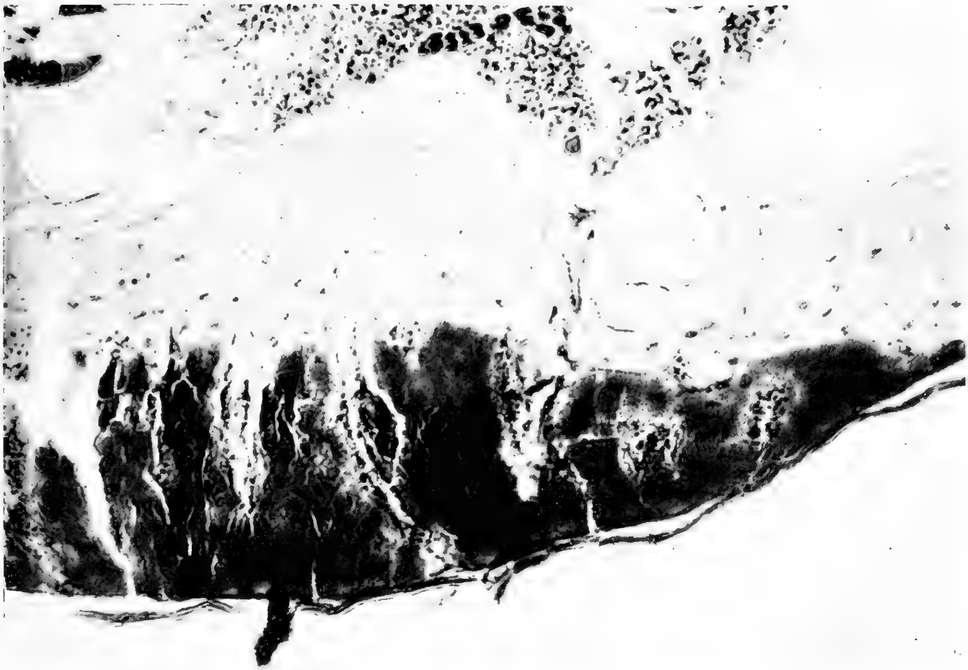
If a number of females are caught and placed in a bottle out of doors on a suitable night, members of the opposite sex will often fly up and light on the coat of the person holding the bottle. It might appear that this is due to an odor emitted by the females which could remain on the person handling them, but the following experiment of S. O. Mast demonstrates conclusively that the light is the determining factor. If a female is placed where the reflection of her flash may be seen in a mirror by a male, he will start for the mirror every time she flashes, even if some color screen be interposed. This brings up another question, how the male can determine whether the flash is that of a female or not, if its color be thus changed. It seems probable that the duration of the flash is in this case important, and many observers have deduced that the flash of the female differs slightly in duration from that of the male, although often the difference is imperceptible. In some species the male emits two short flashes consecutively, while the female emits one long fulmination of light. In such a case, the duration of the flash would explain the matter satisfactorily, and it seems probable that differences detected by the insects might be too minute for the human eye to observe.

CONTRADICTORY CASES

In one species of Lampyridae, the larva possesses photogenic power while the adult does not. In such a case, the light can hardly be a secondary sexual character. Furthermore, the glow-worm frequently mates in the day time, when the light would be of practically no use. But evidence points strongly to the fact that the flash is of assistance to the male in locating his mate in many instances.

But whatever its use, the mechanism which produces the light is perhaps more of a mystery than the use itself. The structure of the photogenic apparatus is apparently the same in all species. As heretofore mentioned, in Photinus, the male has more fully developed photogenic organs than has the female, while in Photuris, both sexes are equally provided. When the flash is emitted, the entire abdomen generally glows, but this is due to part of the photogenic apparatus, and not to any fluorescence of any part except the definitely marked photogenic areas of the abdomen.

Throughout all of the light organs, fine tubes are found, connected with the main air system and evidently the pathway of oxygen. This would seem to indicate that oxidation is the source of the light, and that air is forced through the fine passages in the photogenic tissue, where the oxidation might take place. If one part of the light organs is paralyzed by pressure, it will not flash but merely glows, while the



HOW THE LIGHT OF THE FIREFLY IS PRODUCED

Cross-section of lower part of a firefly's abdomen, magnified about three hundred times. The dark tissue at the bottom produces the light; it is backed up internally by a reflecting layer, which appears very light in the photograph. The small dots in this layer are the nuclei of the cells of which it is composed. The reflecting layer diffuses the light and may also serve to guard the insect from injury by its own illumination. Throughout the two layers can be seen the canals or trachea which conduct air—for oxygen appears to be necessary to oxidize the light-producing substance of the firefly. Photomicrograph by John Howard Paine. (Fig. 16.)

other unparalyzed parts will go on flashing as usual.

Between the light organs and nervous system intervenes what is called a reflecting layer. This layer does not directly reflect, however, but rather diffuses the light so as to make the entire abdomen appear as though glowing. This layer may protect the nervous system from some possible bad effects of the direct light, and many think it serves still another purpose of being the storehouse for some substance which plays an active part in the light production. Whether or not it contains the stored-up supply of oxidizable materials, however, must still remain in the realm of conjecture.

The photogenic property of the abdominal segments is independent of life, for if the organs are dried and ground to powder, light reappears under the influence of air and moisture.

Often the photogenic properties may be observed in the eggs while they are still in the ovaries, and nearly all the larvae of the illuminating species show fluorescence. Does the insect store up "fuel" in its earlier stages which gradually becomes exhausted during the use of the light-emitting apparatus when adult? There is some slight evidence to show that this might be the case, but sufficient knowledge has not yet been gained to make it possible to reach any definite conclusion.

INTENSITY OF THE LIGHT

The intensity of the insect's light is remarkable. It varies greatly, but the most reliable tests made on the insects frequenting Washington, D. C., place

the candle power of the glow at 1/50,000 and that of the flash at 1/400. Although this seems a small amount, in comparison with the size of the insect it is truly surprising.

There are practically no invisible rays in the firefly's light, and hence no heat and a remarkable efficiency. The efficiency of Photinus has been rated from 90% to 96.5%, while the efficiency of a carbon glow lamp is but 0.4%, and the most efficient form of artificial illuminants produced by man are but 4% efficient. Nothing is known about the energy input of the insect, but the resulting light is the most efficient known to science. To supply an equal amount of light from the same illuminated area in the laboratory would require a temperature of 2,000° F.

If the insect is forced by stimulation to keep flashing continuously, life soon becomes extinct, apparently from exhaustion. This indicates that the energy input is considerable on the part of the insect; it is also possible that there may be some reservoir of stored-up light energy which cannot be replenished indefinitely.

There is apparently absolutely no radiation of heat during the flashing, as measured by the most accurate means obtainable, which practically preclude the possibility of error. No infra-red rays are thrown off, for if there were, the insect would soon be dessicated by its own heat. The body temperature of the photogenic segments is higher, however, than the temperature of other parts of the body.

Popular opinion frequently to the contrary, the light of the firefly is connected in no way with any "phosphoresence" or "X-rays." It seems most probable that it is the result of the presence of moisture, oxygen and some unknown substance, possibly a fat or an albuminoid, together with some form of oxidation taking place. Unless some startling and heretofore undiscovered endo-thermic action is going on whereby light is emitted, there seems to be no other possible explanation of the fluoresence. Some observers have suggested phosphuretted hydrogen or carbon to be oxidized, while some think the light to be the result of the breaking down of some nitrogenous substance to form crystalline urates. Every opinion is backed by some evidence, but none is based upon sufficient grounds to make it entirely plausible from every point of view, so that the whole matter is still as much in doubt as ever.

The Psychology of Special Abilities and Disabilities

THE PSYCHOLOGY OF SPECIAL ABILITIES AND DISABILITIES, by Augusta F. Bronner, Assistant Director of the Juvenile Psychopathic Institute, Chicago. Pp. 269. Price, $1.75. Boston: Little, Brown & Co., 1917.

Psychologists as well as eugenists have lately been emphasizing the fact that no two children are alike, but the schools have found it difficult to act on this fact. Dr. Bronner's book presents the problem of individual differences clearly and strikingly. She describes many detailed cases, and discusses the general principles involved, where a subnormal child has special ability in some particular line, and deals more shortly with children who are normal in most ways but in whom some one mental function may be defective. The book is so simply written that it will appeal to parents and teachers, as well as to specialists; but the former should be warned that they may easily get a false idea of individual differences, because of the emphasis which Dr. Bronner lays on extreme cases. As a fact, good qualities usually go together, and bad qualities usually go together. A child who is deficient in several mental functions is more likely than the average to be deficient in all mental functions. Intelligence tends to form a *level*, instead of a system of peaks and valleys, but an unguarded consideration of the selected cases Dr. Bronner presents might lead the reader to think the reverse is the case.

COLOR INHERITANCE IN MAMMALS

II. The Mouse—Better Adapted to Experimental Work than Any Other Mammal—Seven Sets of Mendelian Allelomorphs Identified—Factorial Hypothesis Framed by Cuenot on Basis of His Work with Mice

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IN THE first paper of this series,[1] a classification of color factors in mammals was suggested on a hypothetical chemical basis. A general discussion was given of the factors belonging to each class. The present and following papers attempt to give a more detailed analysis of the present state of our knowledge on the subject in each of the mammals on which work has been done.

By far the most experimental work has been carried on with four rodents—the mouse, rat, rabbit and guinea-pig, and the factors have been determined with very much more certainty than in the larger animals. A few facts are known in regard to other rodents.

Among the larger domestic animals it is a curious fact that the amount known is in inverse relation to the difficulty in breeding. The color factors of the horse have been quite thoroughly worked out. Cattle stand next, while in sheep, goats and hogs our information is rather scanty. The reason for this inverse relation is easy to understand. Just because of the slowness of breeding horses, there has been, for the most part, but little attempt to fix the colors in the different breeds. Thus stud book records show all kinds of matings with segregation of the colors in the offspring. The breeds in cattle have been fixed in color to a greater extent than in horses but the Shorthorns and Highlands, at least, continue to produce several colors. In swine, each breed has its characteristic color and nothing can be learned from the records. In European breeds of sheep, all colors have been nearly eliminated except white, owing to the greater desirability of this color for wool. Other colors exist as in the tan and black Barbados, but little is known of their inheritance.

Dogs and cats are even richer in color varieties than the rodents, but the factors are none too well understood. Finally in man, the problems in color inheritance appear to be of an unusually difficult nature.

CLASSES OF COLOR FACTORS

In the previous paper color, factors were classified into four groups defined as follows:

1. Factors which affect distribution and intensity of color, largely irrespective of the kind of color.

(*a*) Factors which affect the distribution of color in contrast with white.

(*b*) Factors which affect the intensity of color in all colored areas of the skin, fur and eyes.

2. Factors which affect the distribution and intensity of the differentiation from yellow to black—effects, of course, visible only in colored areas.

(*a*) Factors which affect the distribution of a dark color (black, sepia, brown, etc.) in contrast with a yellow.

(*b*) Factors which affect the intensity of only the dark colors with effects visible wherever such colors develop in skin, fur and eyes.

In a more detailed study of the factors a rough subdivision of classes 1a and 2a becomes convenient. This gives eight classes which may be defined briefly by the following list of characteristic variations.

[1] Wright, S. 1917. JOUR. HEREDITY, 8:224–235.

	Example
$1a_1$ White pattern (roan type)	roan cattle
$1a_2$ White pattern (piebald type)	Dutch rabbit
$1a_3$ Dilution of all colors (maltese and light red type)	blue rabbit
1b Dilution of all colors (sepia and cream type, albinism)	dilute guinea-pig
$2a_1$ Yellow pattern (agouti type)	gray rabbit
$2a_2$ Yellow pattern (tortoise type)	tortoise guinea-pig
$2a_3$ Density of black (sooty type)	sooty rabbit
2b Dilution of black only (brown type)	brown mouse

While the lines between these classes especially between $2a_2$ and $2a_3$ cannot be drawn very closely, most factors are readily placed.

In the discussions of the different mammals, a list is given of the Mendelian factors which have been thoroughly demonstrated in the opinion of the writer. They are classified according to their apparent physiological effects under the scheme above. The effect is given in more detail by a brief description of the color variety which differs by only the unit factor in question from a certain type, that of the wild species, where this is known. The color of a variety which differs from the type by more than one factor is easily deduced in all cases. Thus a mouse which differs from the gray color of wild mice only by factor s is a piebald gray, by factor b is a cinnomon gray in which the black parts of the fur are changed to brown, while a mouse which differs by both is naturally a piebald cinnamon. Where the two factors are in the same class, a double effect is produced. Thus a mouse like the wild in formula except for factors p and b has a double dilution of black, the black parts of the fur becoming very pale brown.

No wholly satisfactory system of symbols for Mendelian factors seems yet to have been devised, and there is little uniformity among authors. Where only a pair of allelomorphs is known, the present paper follows the convenient system of representing the dominant factor by a capital, the recessive by a small letter. The same letter with different subscripts is used for systems of multiple allelomorphs.

GRAY MOUSE—SVICABP

(Pattern of black and yellow)

$1a_1$	—	
$1a_2$	S,s	s piebald
	V,v	Vv piebald, ssVv black-eyed white
$1a_3$	I,i	i pale gray (blue and light yellow)
1b	C,c	c albino (white with pink eyes)
$2a_1$	A_Y,	A_L, A, A_b A_Y yellow, A_L light bellied gray, A_b black
$2a_2$	—	
$2a_3$	—	
2b	B,b	b brown-eyed brown agouti (brown and yellow)
	P,p	p pink eyed agouti (lilac and yellow)
		Unanalyzed
$1a_2$		Blaze and minor variations in piebalds
1b		Cream in place of yellow or red
$2a_3$		Black or sooty yellow in place of yellow as in sables and black and tans

THE FACTORS OF MICE

In many respects mice have been found to be better adapted for experimental work than any other mammal. From the first they have attracted a great number of investigators, among whom first place must be given Cuénot[2] whose work has had a most profound influence on genetic theory apart from its bearing on inheritance in mice. The results are in harmony on most points and the essential facts may be considered as very thoroughly established. Seven sets of Mendelian allelomorphs, as listed above, have been identified. At least two important series of variations do not seem to follow simple Mendelian inheritance and have so far defied analysis.

Excluding the second piebald factor, each of the other six sets of allelomorphs

[2] Cuénot, L. 1902–11. *Arch. Zool. Exp. et Gén.* (3), 10; (4), 1, 2, 3, 5, 6, 8.

has been combined with others in such a way as to demonstrate its place as an independent set. The second piebald factor does not appear to have been combined with the brown and dilution series, but will no doubt be found independent when so combined. The agouti series of four allelomorphs was discovered by Cuénot[3] and thoroughly confirmed by Sturtevant,[4] Morgan,[5] and Little.[6]

There remains to be considered the possibility of linkage between the different series of allelomorphs. The linkage relations of the piebald factors do not seem to have been thoroughly investigated except that Little[7] has shown them to be nearly or quite independent of each other, and the first one is known to be independent of albinism (Cuénot,[8] Allen,[9] and Durham.[10]) Dilution, non-agouti, brown eye and pink eye were shown to be without appreciable linkage in a four-factor cross involving very large numbers made by Little and Phillips.[11] These results are also in harmony with those obtained by Cuénot and Miss Durham. The relation of albinism to the others has not been worked out very thoroughly, but one case of partial linkage here is very probable. Darbishire[12] crossed pink-eyed colored mice with albinos from dark-eyed strains (CCpp x ccPP). F_1 were all dark-eyed. In F_2 there were 137 albinos, 284 dark-eyed and 134 pink-eyed colored. Darbishire recognized the closeness to a 1:2:1 ratio. This is to be expected on complete linkage, but not on independence, in which case the ratio should be 4:9:3. Cuénot,[13] in the same cross, obtained 21 albinos, 46 dark-eyed and 25 pink-eyed colored, in close agreement. Combining, the ratio of dark-eyed to pink-eyed is 330:159 with a deviation of 5.7 times the probable error from the expected 3:1 ratio. Tests of F_2 individuals bear out the theory of linkage, but also show that linkage is far from perfect.

PIEBALD MICE

Some very interesting work has been done on piebald mice. The pattern is variable in extent, and apt to be markedly asymmetrical. All variations exist between self and black-eyed white. Cuénot[14] showed that the pied character behaves in general as a Mendelian recessive to self and is inherited independently of albinism or the quality of color of the mouse. These results have been confirmed by all later workers. Cuénot recognized that much of the variation is merely developmental, being unrepresented in the germ plasm. He suggested, however, that a series of multiple allelomorphs such as he had found in the yellows and agoutis was responsible for the gradations. That such allelomorphs may exist is very probable in view of conditions found in rats, but it has never been critically demonstrated. On the other hand, another piebald factor has been discovered which has been shown by Durham,[15] Little,[16] and Detlefsen[17] to be independent in inheritance, but to coöperate with the first in development. The case has been most thoroughly worked out by Little who found that the second piebald factor could not be obtained in a homozygous condition, thus resembling the well known case of the yellow mice. The situation as he found it was as follows:

[3] Cuénot L. 1904. *Arch. Zool. Exp. et Gén.* (4), 2, Notes et revue 45–56.
[4] Sturtevant, A. H. 1912. *Amer. Nat.*, 46:368–371.
[5] Morgan, T. H. 1914. *Amer. Nat.*, 48:449–458.
[6] Little, C. C. 1914. *Amer. Nat.*, 48.
[7] Little, C. C. 1915. *Amer. Nat.*, 49:727–740.
[8] Cuénot, L. 1904. *Loc. cit.*
[9] Allen, G. M. 1904. *Proc. Amer. Acad. Arts and Sci.*, 40:61–163.
[10] Durham, F. M. 1908. *Rept. Evol. Com. Roy. Soc.*, 4:41.
[11] Little, C. C. and Phillips, J. C. 1913. *Amer. Nat.*, 47:760.
[12] Darbishire, A. D. 1903, 1904. *Biom.*, 2:101–104, 163–173, 282–285; 3:1–51.
[13] Cuénot, L. 1907. *Arch. Zool. Exp. et Gén.*, (4), 5. Notes et revue, p. 1.
[14] Cuénot, L. 1904. *Loc. cit.*
[15] Durham, F. M. 1908. *Loc. cit.*
[16] Little, C. C. 1915. *Loc. cit.*
[17] Detlefsen, J. A. 1916. *Amer. Nat.*, 50:46–49.

	vv	Vv	VV
SS	self	slightly pied	not born
Ss	nearly self	pied	not born
ss	pied	black-eyed white (or nearly so)	not born

It seems questionable whether this should be called a dominant white. It cannot, of course, be determined whether the heterozygote Vv is closer to the unknown homozygote VV than to self vv, but it may be pointed out that the ordinary piebald factor would be considered dominant if the homozygote ss were not known, as would also be the case in Dutch rabbits and hooded rats. In man a white blaze is generally considered to be due to a dominant factor, but as no cases have been reported in which homozygotes would be expected to appear, it is not at all unlikely that it is no more dominant than the piebalds in rodents. In any event, the two piebald factors must be classified together. Both of them affect color in general and must be considered as acting on enzyme I of the previous paper. Further they must be considered as doing this through influence on a common developmental factor back of enzyme I. If their modes of influence on enzyme I were wholly independent of each other in development, we would expect one pattern to be simply laid over the other as in white patterns often found in roan Shorthorn cattle, or in the relations of piebald in mice with the white belly of many light-bellied agouti mice. But in the combination ssVv it is the quantity of white, not the pattern, which is combined.

No doubt there are other factors with smaller effects than these two which are inherited independently but coöperate in development. Little[18] describes wild mice with the formula of self SSvv, which yet had a white blaze. The mode of inheritance was irregular although there were distinct indications of segregation.

The dilution of blue mice was demonstrated to be due to a recessive factor by Miss Durham.[19] Little[20] confirmed this result and showed that there is another kind of dilution in mice which produces even more striking effects in yellows and is inherited independently. It seems to follow practically a mode of blending inheritance which has not yet been analyzed as Mendelian. According to Little, factor i reduces black to blue, and red to a peculiar washed-out light red, while the second type of dilution has no appreciable effect on black, but reduces red to a cream in which the hue is different from light red. Factor i evidently belongs in class $1a_3$. It is very different from the dilution of sepia guinea-pigs and has been shown by Miss Durham to be transmitted independently of albinism. The cream type of dilution does not seem to fall into any of the classes given as no provision is made for dilution of yellow without coördinate dilution of black. However, it is characteristic of the dilution of class 1b that much greater effect is produced on yellow than on black. Thus in dilute guinea-pigs (C_dC_d) the yellow parts of the fur are markedly paler than the red of intense ones (CC) yet the black parts are hardly distinguishable. It is only in the lower combinations of the albino allelomorphs in guinea-pigs such as C_dC_a, the heterozygote between dilute and albino, that marked dilution of black becomes apparent. Thus unanalyzed dilution of mice must be placed in class 1b and can be compared with the unanalyzed minor variations in intensity in guinea-pigs which coöperate with the albino series.

Complete albinism of mice was the first Mendelian factor to be demonstrated in mammals. Cuénot's[21] result has been confirmed by all later workers. In rats, guinea-pigs and rabbits variations have been discovered which are intermediate between full color and albinism and in all three it is clear that albinism is the extreme in a dilution series and is wholly independent of the

[18] Little, C. C. 1914. *Amer. Nat.*, 48:74–82.
[19] Durham, F. M. 1908. *Loc. cit.*
[20] Little, C. C. 1911. *Sci. N. S.*, 33:896–897.
[21] Cuénot, L. 1902. *Arch. Zool. Exp. et Gén.*, (3), 10. Notes et revue, p. 27.

so-called partial albinism of piebalds. In mice, no intermediate allelomorphs have been discovered, but it is most probable that it is homologous with albinism in the other rodents and therefore to be placed in class 1b.

VARIATIONS OF YELLOW

When Cuénot[22] discovered that the differences between the various colors could be transmitted by albinos as well as by mice in which the colors were visible he devised the very successful factor hypothesis as an explanation. He did not, however, attempt to force all color differences into pairs of allelomorphs. He found that yellow, gray and black behaved as if due to three variations of the same factor, each one being an allelomorph of either of the others. Later[23] he added light-bellied agouti as a variation between yellow and ticked-bellied agouti or gray. Cuénot[24] also discovered the curious fact that yellows could not be obtained in a homozygous condition, a result confirmed by Miss Durham,[25] Castle, Little[26] and others. Kirkham's[27] recent demonstration of excessive degeneration among embryos from the cross yellow by yellow is a most interesting physical confirmation of a conclusion based on genetic evidence.

It may be noted here that other kinds of yellows may exist among mice. Hagedoorn[28] has announced some very peculiar results including work on dominant and recessive strains of yellow mice both of which could be bred true and, therefore, were different from the yellows of all other investigators. His results, however, need confirmation as they were in many cases inconsistent with his own interpretation.[29]

A white-bellied gray mouse (A_LA_L) differs from a black (A_bA_b) in several respects. Each hair on the back is black at the base and tip with a yellow band between and on the belly each hair may be white throughout. A black mouse has solid black hair all over. Thus the same factor appears to determine a pattern difference between back and belly, a curious cycle in the development of colors on the back and complete or nearly complete inhibition of all color on the belly. Physiologically, however, the case is probably not as complex as at first appears. By crossing with very intensely colored mice the belly may be changed from white to yellow, and black can be brought out at the base of the hairs. It is evident that the belly really differs from the back in having a widening of the yellow band to cover the whole hair and in a dilution of this yellow nearly or entirely to white. Neither of these differences is necessarily determined by the agouti factor, but is merely revealed by the latter. The case is entirely comparable with that of the gray rabbit discussed in the previous paper. No doubt the belly differs from the back even in solid blacks in having a lower density of black and also a lower level of color production in general, only revealed when the agouti factor introduces an inhibitor of black into all parts of the coat. This inhibitor finds less of the black-producing enzyme to inhibit on the belly, and so produces a wider band which, however, appears white instead of yellow because differentiation during development has left the general level of color production on the belly below the threshold for yellow. Thus the four allelomorphs of the agouti series can be interpreted as determining simply four different rates of production of an inhibitor for black.

A series of variations of yellow has

[22] Cuénot, L. 1903. *Ibid.* (4), 1, Notes et revue, 33–41.
[23] Cuénot, L. 1907. *Loc. cit.*
[24] Cuénot, L. 1905, 1908, 1911. *Loc. cit.*
[25] Durham, F. M. 1911. *Jour. Gen.*, 1:159–178.
[26] Castle, W. E. 1906. *Sci. N. S.*, 24:275–280. (And C. C. Little. 1910. *Sci. N. S.*, 32:868–870.)
[27] Kirkham, W. B. 1916. *Abstracts Amer. Soc. Zool.*, p. 8.
[28] Hagedoorn, A. 1908, 1909. *Univ. Cal. Pub. in Physiol.* 1912. *Zeit. f. Abst. Ver.*, 6:97–136.
[29] See for example, Cuénot, 1911, *loc. cit.*; Plate, 1912, *Zeit. f. Abst. Ver.*, 6; Little, 1914, 48:74–82; Lang, 1914, *Experimentelle Vererbungslehre.*

long been known which does not enter into the linear series just discussed. These are the sooty yellows, sables, and black-and-tans investigated by Miss Durham,[30] Little[31] and Dunn.[32] In the sooty yellows more or less black pigment is mixed with the yellow on the back, while in black-and-tans the entire back is black leaving only the belly yellow. These variations are independent, genetically, of the yellow factor and can be introduced readily into grays, producing gray-bellied blacks, and into blacks, producing very dense blacks. They are spoken of as deepeners of black. The mode of inheritance is irregular and has not been analyzed. Physiologically these factors may be considered as increasing the rate of production of enzyme II, thus increasing the absolute amount of the differentiation between back and belly spoken of above and giving the agouti factors more to inhibit especially on the back. These deepening factors appear to have no effect on the intensity of yellow as the belly in black-and-tans may be any color from red to white. They clearly belong in class $2a_3$.

VARIATIONS OF BLACK

Two Mendelian factors are known which vary the intensity of black without influence on the yellow parts of the coat, but which act in a fundamentally different way from the deepeners of black just dealt with. The latter are in a sense alternative in their affect on pigment. With them a granule is either black or yellow and the intergrade between black and yellow in the fur is sooty yellow. In the brown-eyed brown mice,[33] and the pink-eyed lilacs,[34] on the other hand, the character of the pigment seems to be really intermediate between black and yellow, uniformly throughout skin, coat and eye. The effect is a brown. Again, increase in intensity among the deepening factors has a very direct relation to the effect of the agouti factor and suggests titration of an increase in enzyme II against an inhibitor. The width of the yellow band of agoutis also increases to some extent when black is changed to brown or lilac but not to anything like as marked an extent. Indeed, Dunn has been able to produce brown-and-tans in which brown takes the place of black in black-and-tans. In the first paper it was suggested that such variations as black-and-tan could be pictured as representing variations in the actual quantity of a specific enzyme for the production of dark colors, while in browns and lilacs there is no reduction in the quantity to be titrated against inhibiting agents, but a reduction in potency of some other kind so that pigment is produced intermediate in character between black and yellow Such variations are put in class 2b.

The Marriage Rate of the Insane

The marriage rate of the insane is discussed by Dr. A. Myerson, pathologist of the Taunton State Hospital, in in the January, 1917, issue of the *American Journal of Insanity.* Basing his conclusions on a study of 663 families, he finds that the female insane and the general paretics, both male and female, marry in slightly less proportion than does the general population. Alcoholic males marry in much reduced ratio, while alcoholic females marry in nearly normal ratio. It is to the dementia praecox group that marriage offers the greatest difficulty, for here both the male and female ratios are very low and the former, the male rate, is only about one-half the latter, the female rate. To some extent, then, all types of mental abnormality act as barriers to reproduction, but in the female sex the hindrance is very slight.

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[30] Durham, F. M. 1911. *Loc. cit.*
[31] Little, C. C. 1913. *Carn. Inst. Wash. Pub.*, 179: 11–102. 1916. *Amer. Nat.*, 50: 335–349.
[32] Dunn, L. C. 1916. *Amer. Nat.*, 50: 664–675.
[33] Cuénot, L. 1905, 1907. *Loc. cit.* Durham. 1908. *Loc. cit.*, etc.
[34] Cuénot, L. 1907. *Loc. cit.* Darbishire. 1904. *Loc. cit.* Castle and Little. 1909. *Sci. N. S.*, 30:313–314. Plate, 1910. *Zool. Anz.*, 35:634–640. *Durham.* 1911. *Loc. cit.*, etc.

COLOR INHERITANCE IN SWINE

Heredity Appears to be Mendelian—Some New Facts from Unusual Crosses—Body Stripes Characteristic of the Primitive Wild Boar Have Not Yet Been Eliminated

B. O. Severson, *State College, Pa.*

MENDEL'S principles of unit characters, dominance and segregation seem manifested in color characters of swine. Smith[1] showed in the case of the Yorkshire crossed with the Berkshire or Poland China that white was dominant over black in the F_1 generation. Secondly, in the F_2 generation, the colors showed "a general tendency for the original parent colors to be expressed separately and in the proportion of three dominants to one recessive." Thirdly, "in nearly all cases the recessive black of the F_2 generation carried more white than the original black parents. This suggests the requirement of a number of germinal factors for each color rather than a single factor." Q. I. and J. P. Simpson[2] in a study of crossing various breeds of swine, state, "The exact application of Mendel's law to all swine hybrids, where the initiative subjects have been proven pure and homozygous in germ, and the similarity of process in all sexual animals and plants in chromosome reduction preparatory to fertilization, leads us to conclude that when pure they will all obey Mendel's laws absolutely; and when marked deviation in the hybridization is found it is proof positive of contamination in one or both subjects."

In the spring of 1915 a litter was farrowed, the result of mating a Berkshire sow, Dora XVIII of Penn State 199,330 with a Duroc Jersey boar, Fancy King 58,875. In this litter of seven pigs, six were red with black spots and one (see Fig. 17) was black with white spots. In the spring of 1917 another litter, the result of mating another pure bred Duroc Jersey boar with a pure bred Berkshire sow, produced five pigs, four of which were red with black spots and one black with the white markings of a Berkshire. The appearance of black and white in the F_1 generation of this cross had never been observed in a similar mating at the Pennsylvania State College. Because of this unusual case of a black and white sow pig in the F_1 generation (1915), she was selected with a sister of the same litter possessing the usual red and black colors to be used for further investigation. In the case of the black and white pig farrowed in 1917, its hereditary color factors have not been investigated.

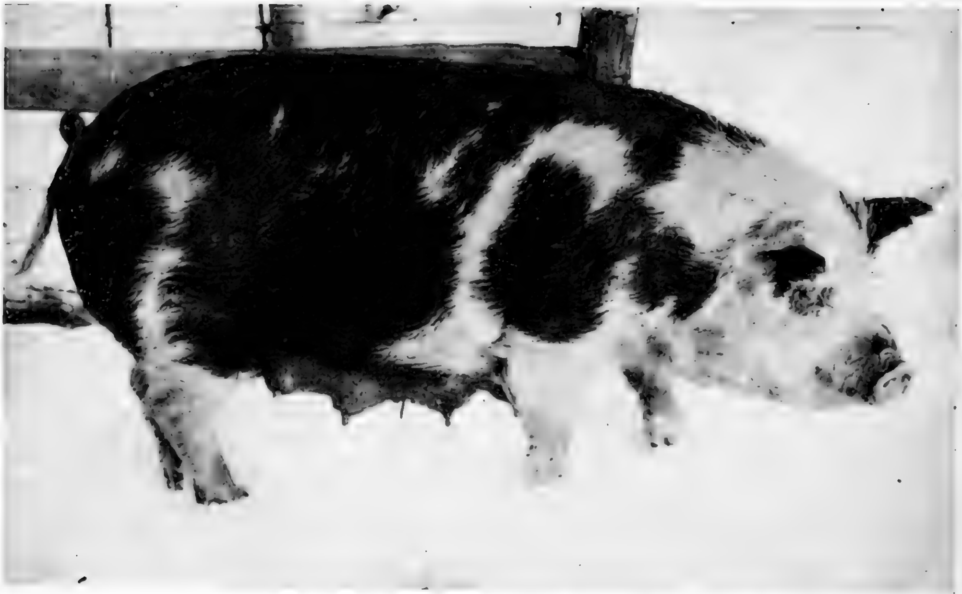
The black and white crossbred sow, born in 1915, was designated No. I and her litter mate was designated No. II. These sows, (F_1 generation) were both mated at one year of age to a pure bred Berkshire boar, Rival's Duke XXII 193,441, the object being to determine whether the black and white sow, No. I, possessed any hereditary factor for red. Sow No. II was used as a check.

Results of Mating

Breeding		Color of offspring			
Boar	Sow	Red and black	Black and white	Red, white and black	Yellow and black
* Duroc Jersey, 58,875	Berkshire, 199,330	6	1	..	..
† Berkshire, 193,411	Cross Bred No. I	1	5	2	1
† Berkshire, 193,411	Cross Bred No. II	2	4	4	..

* F_1 generation. † F_2 generation.

[1] Color Inheritance in Swine, *American Breeder's Magazine*, Vol. iv, p. 113.
[2] Analytical Hybridization, *Proceedings A. B. A.*, Vol. vii, p. 266.



UNUSUAL RESULT OF A BERKSHIRE X DUROC JERSEY CROSS

Crossbred sow born at Pennsylvania State College in 1915 from mating of Berkshire sow and Duroc Jersey boar. The usual result of this cross is a red pig with black spots, but this animal is black instead of red, with white spots or blotches. While she did not show any red, she carried it in her germ-plasm, for when she was mated to a Berkshire boar she farrowed nine pigs, eight of whom had some red hair. (Fig. 17.)

The litter from the cross-bred sow No. I (black and white) when mated with a Berkshire boar showed greater variation than the table indicates. The white hair on this sow during the late summer of 1915 became yellowish which is usual in white swine, but in the winter appeared pure white. However, at about one year of age a light reddish streak appeared between the ears and extended over the dorsal region of the neck or 4 for 5 inches.

In her litter, the five pigs designated as black and white, only one could be described as being pure black with white spots. The other four possessed sandy-colored hair (reddish tint) about the snout. Only one pig was red and black, and in this case the black predominated over the body with spots of red hair. The predominance of black over red in the F_1 generation has never been observed by the writer in the F_1 generation of a Berkshire Duroc Jersey cross. The usual color marking of the F_1 generation did not appear in the second generation when sow No. 1 was mated to a Berkshire boar. One pig was a bright brownish yellow and piebald black. Two pigs showed the three colors black, red and white distinctly. One of these tri-colored pigs possessed a black body with irregular spots of red and white. The other pig possessed five longitudinal stripes of reddish hair on a black body spotted with white hair. This last case is interesting because the young of the "wild boar" are marked with longitudinal body stripes. This seems to be an exception to the statement made by Castle:[3] "This banded character of both young and adult has apparently been lost in all domestic breeds [swine] which are either self black, red or white or else black or red spotted with white." The only explanation of these longitudinal body stripes seems to be that their hereditary determiners have not been entirely eliminated from improved breeds of swine.

Due to the fact that eight out of the nine pigs in the litter from cross bred sow No. 1 showed red or traces of red

hair, it is evident that this sow carried a germinal factor for the red color. The Berkshire is claimed to possess heredity for red, but in this case there is no apparent ground for believing that sow No. 1 did not possess factors for three colors, black, white and red.

In the case of the cross bred sow No. II a litter of ten pigs resulted from a mating with the same Berkshire boar that sired the litter of cross bred sow No. I. This sow possessed a red body and was spotted black. Like sow No. I, sow No. II changed noticeably in color after one year of age; as she matured the red hair on the belly and face became a pale yellow. The litter from sow No. II was more uniform in color than that from sow No. I. Two pigs were red with black spots, four were black with white spots and four were reddish black with white spots.

Apparently there seems to be a reversion of dominance in color of sows No. I and II. In the case of No. I the black replaces the usual red body color and white replaces the usual black spots of the Berkshire Duroc Jersey cross. In sow No. II, which had the usual red body with black spots, the white hair was either recessive or inhibited by some other factor. In the case of sow No. I the factor for longitudinal body stripes possessed by the wild boar may have inhibited the expression of her red factor. The fact that she did show a light streak of red over the dorsal region of the neck leads to this suspicion.

COLOR IN OTHER CROSSES

My observations with reference to the color shown in the crossing of the various breeds in the F_1 generation are as follows:

1. Berkshire x Tamworth.
   Red (darker than Duroc Jersey) with black spots.
2. Berkshire x Duroc Jersey.
   Red (varying shades) with black spots.
   Black (rare) with white spots.
3. Berkshire x Yorkshire.
   White (solid).
   White with black spots (rare).
4. Yorkshire x Tamworth.
   White (solid) with reddish tint.
5. Yorkshire x Duroc Jersey.
   White (solid) with reddish tint.
6. Berkshire x Chester White.
   White (solid).
   White with spotted black (high proportion).

These observations do not agree with the general opinion and statements that the self white of the Yorkshire is completely dominant over the red of the Tamworth and Duroc Jersey.

A Classical Study of Criminals

Considerable progress is being made on the problem of heredity vs. environment, by exact methods of investigation, J. B. Miner remarks in the May issue of the *Psychologicial Bulletin.* He thinks that Goring's fundamental research in this field is so important that it should be more generally available. This research covered scores of measurements and objective facts about three thousand British convicts. It took about ten years to complete. The conclusions rest upon the most complete treatment of the data under the advice of Karl Pearson of the Biometric Laboratory. It is a classical example of the importance of multiple correlation in resolving complex problems. It first thoroughly refutes the claims of the school of Lombroso as to the existence of a physical criminal type by showing that over thirty suggested physical characteristics are not related to criminality. Goring then demonstrates that criminality runs in families, but mainly through its relation to intellectual deficiency, which shows a correlation of .66 with criminality. Through deficiency it becomes associated with alcoholism, epilepsy and social profligacy. Moreover, numerous external factors, such as example in the home, schooling, size of family, economic and employment conditions, were found to have no significant relation to frequency or length of imprisonment. The correlations indicated that ". . . relatively to its origin in the constitution of the malefactor, and especially in his mentally defective constitution, crime in this country is only to a trifling extent (if to any) the product of social inequality, or of adverse environment . . ."

[3] Castle's "Genetics and Eugenics," p. 137.

THE EXPLANATION OF SELF-STERILITY

E. M. East, *Bussey Institution, Forest Hills, Mass.*

IN A recent paper by C. W. Moore[1] on the subject of self-sterility, several ill-advised statements were made to which attention should be called.

The paper begins with the sentence:

> Several who have made a study of the problem of the inheritance of self-sterility of plants have obtained results which did not point to any one definite manner in which flowers act when self-pollinated.

One might read into the meaning of this statement either that there was great difference of opinion regarding the behavior of self-sterile plants or that little was known regarding self-sterility before the appearance of the paper under discussion. As a matter of fact a great many details regarding self-sterile plants are known. Darwin dealt with the matter at some length, and more recently extended researches by Jost, Correns, Compton and Stout have appeared. The present writer has also investigated the subject rather minutely although only preliminary reports of the work have been published. As to the gross facts, there is not a great difference of opinion among the later writers. Each has found that pollen grains germinate after self-pollination as readily as they do after cross-pollination, but that they grow more slowly, and the present writer has determined that the growth curves of self-pollen tubes are approximately straight lines, while growth curves of cross-pollen tubes are similar to those of autocatalytic reactions. Each has found that there is cross-sterility of the same nature as self-sterility. In other words, the plants of a self-sterile race are not only self-incompatible, but some combinations are cross-incompatible. The differences of opinion come in interpretation of these results, and these differences are due largely, we believe, to the fragmentary character of the evidence.

Moore founds an hypothesis by which to explain self-sterility on the supposed fact that self-tubes are greater in diameter than cross-tubes. In fact this seems to be the main thesis of his paper. He says:

> . . . the greater width of the self-pollinated pollen tubes of Tradescantia is due to the fact that the food supply is more favorable to the nourishment of a self-pollen tube than it is to a cross-pollen tube. On account of the abundant food supply the pollen tubes did not lengthen, but grew wider since they were in a very favorable medium. By this hypothesis it is possible to explain most of the data here presented. . . .

What Moore did was to measure *short* self-pollen tubes and *long* cross-pollen tubes as he distinctly states on page 204. Now if he had measured self-pollen tubes and cross-pollen tubes of the same length, as he should have done, it is almost certain that he would have found them to be of the same width. At least this is the observation of the writer on numerous pistils of three different self-sterile species of Nicotiana. Moore's main thesis, therefore, seems to be based upon an improper observation.

The second point made in the paper, involving a criticism of the present writer, is similarly without foundation He says:

> He [East] states that "all gametes having in their hereditary constitution something different from that of the cells of the mother plant, however, can provoke the proper secretion to stimulate the pollen tube growth, reach the ovary before the flower wilts, and produce seeds." From this it may be inferred that there may be an enzyme in the pollen grain that in a cross-pollination is able to induce the stigma to excrete a stimulating substance so that the pollen tube is able to grow. In a self-pollination this enzyme is not able to act. However, if this were the case, when a few cross-pollen grains were placed on a self-pollinated stigma, they would be expected to germinate and cause the stigma to produce the stimulating substance. Thus the pollen tubes from the self-pollination would also benefit by the stimulating influence and should b

[1] Journal of Heredity, viii, 203–207, 1917.

able to grow and bring about fertilization. However, the work on alsike clover does not support this hypothesis.

This idea of Moore is diametrically opposed to modern conceptions of colloid chemistry. Plant enzymes do not pass freely through cell membranes and diffuse through the tissues. They are very local in their action as is shown very clearly by the definite lines of demarcation between colors in certain corollas. Nevertheless, to be on the safe side the writer made two experiments calculated to test the effect of cross-pollen tubes on self-pollen tubes. In the first experiment five pistils were pollinated with a definite number of cross-pollen grains under a binocular and then covered with self-pollen. Three capsules matured, and yielded seeds as follows:

Pistil No.	*No. cross-pollen grains used*	*No. seeds produced*
1	51	46
2	48	42
3	50	41

Since the experimental error was probably only plus or minus three pollen grains, the indications are clearly that no self-pollen tubes contributed toward the production of these seeds. But, of course, the matter is not proved definitely. A more critical test was the following: Three pistils of a white-flowered plant breeding true for white flowers were selfed. After a few hours compatible pollen from a plant breeding true for red flowers was placed upon these same stigmas. Capsules full of seed were obtained. These seed, if produced only by the action of the pollen from the red flowered plant should produce only red flowered plants since red is dominant. Not all the plants from these seeds have blossomed, but thus far *no white-flowered plants have been produced.*

The main theses defended in Moore's paper, therefore, are both based upon incorrect observations and upon fallacious reasoning.

The Mentality of Orphans

The mentality of orphans and of children who are dependent on public care for other reasons, is low, according to Professor Rudolf Pintner of Ohio State University, in the *Journal of Educational Psychology* (April, 1917). Stenquist, Thorndike and Trabue, testing dependent children in New York, found that in general they fell below public school children of the same age, in intelligence. Hall secured similar results in New York state orphan asylums. Streeter, testing the children in the orphanages of New Hampshire, found 49% normal, 30% backward and 21% feebleminded. Pintner tested 82 children for the Ohio State Board of Charities and found that only 37% were normal, 19% being feebleminded and the rest backward. A test which he made of 106 children in a county children's home showed 7% who were bright, 35% normal, 11% feebleminded, and the remainder backward.

Disabled Soldiers Marry in England

As soldiers who were disabled at the front are likely to be of superior eugenic quality, it is important to their nation that their disabilities should not prevent them from leaving descendants. The English *Eugenics Review*, which has interested itself in this problem, publishes some interesting facts in its last issue. Of 440 blinded soldiers entering St. Dunstan's Hostel, 144 were previously married and 296, or rather more than two-thirds, were single. Of these single men 55, or 18%, have married since their disablement. It is noted that the wives are to be considered in every case as extremely suitable, and almost without exception as unusually good looking. It is evident, therefore, that the idea suggested recently in England of finding wives for blinded soldiers among those girls who are physically so unattractive as otherwise to be destined to celibacy, is not being carried out.

POLLINATING THE PECAN

Systematic breeding, requiring careful cross-pollination, is of much importance to the pecan grower. The photograph below shows the method which we now find most satisfactory for protecting pollinated blossoms. When the pollen is ripe on thousands of trees at the same time, the air is full of it; and it's the same way with thrips—there are millions of them wherever one turns. Formerly we protected our pollinated blossoms with paper bags large enough to envelop all the leaves, but this did not always keep out foreign pollen and thrips, and it frequently damaged the leaves, which had a corresponding effect on the nuts. We have learned that sound leaves are absolutely necessary from start to finish, for a perfect fruit. The method shown in Fig. 18 is not only secure, but lets the leaves have full benefit of the air and light. So important is the latter, in our experience, that we do all our breeding work on the south side of the trees, where the maximum of sunlight falls. In pollinating, I may add that it is my practice first to breathe on the pistillate blossoms—this seems to make the pollen stick better.

E. E. RISIEN, San Saba, Tex.

PROTECTING POLLINATED PECAN BLOSSOMS

In the lower central part of the photograph is a heavy bunch of catkins (male blossoms): these the operator always strips off. Directly above these is a small square of white paper, on which are some pistillate (female) flowers in a condition to be cross-pollinated. At the left is a cluster of pistillate blossoms protected by being wrapped in cotton batting; opposite this at the right is a similar cluster, the cotton being enveloped with a piece of heavy glacine paper, as a protection from moisture. (Fig. 18.)

The

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CONTENTS

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DESIRABLE SHEEP FOR THE FARM

Three Shropshire ewes—a good breed for mixed farming. Sheep of this general type will clean the weeds out of old pastures and waste land, and if kept by a man who understands his business, their wool will pay all the costs of maintenance, leaving the mutton as clear profit. Young lambs are becoming more valuable each year, and it is impossible for the United States to produce enough in the near future to meet the demand. Cheaper wool and mutton will not be realized until sheep are as common as cows and pigs on the small farms of the United States. Photograph from the U. S. Department of Agriculture. (Frontispiece.)

THE SHEEP COMES BACK

Scarcity of Wool and Mutton, Due to Breaking Up of Open Ranges, May be Remedied by Re-introduction of Sheep into Mixed Farming—Remarkable Demand for Breeding Stock in the United States at Present—Fine-wool Breeds Not Suitable for the Farm.

THAT demand always creates supply is an economic maxim which gets very little support from sheep breeders. Each year mutton and wool grow scarcer, each year buyers are willing to pay a higher price for them, and each year the ranchers raise fewer sheep.

The explanation of this expensive state of affairs must be sought in the world-wide march of civilization. Sheep have always been produced in regions where there was a large area of waste, unfenced land. They have been an accompaniment of the frontier. But the frontier, everywhere, is disappearing. Range land is being cut up for farms. Of the four great sheep countries, Australasia, South America, the United States and South Africa, the latter alone is increasing its sheep range. Broadly speaking, the day of the range sheep is passing. It is, then, an international movement which makes the housewife pay more for smaller lamb-chops, and forces the business man to invest $40 in what was formerly a $30 suit of worsted.

Where is this movement to stop? Will the diner, neatly clad in cotton and wood-fibre, eat his mint sauce on baked beans instead of spring lamb? Probably not, for the law of supply and demand is "coming to," and bringing out a new type of sheep husbandry.

In most countries, sheep have hitherto been grown for wool, with meat as a by-product. The breeds in demand were the fine-wool breeds, evolved by the Spaniards from an oriental stock. These sheep, taken to Mexico from Spain, were secured from Mexico by the western United States, and formed the foundation of the American sheep industry. They cannot be expected, from now on, to be as profitable as "dual purpose" sheep will be.

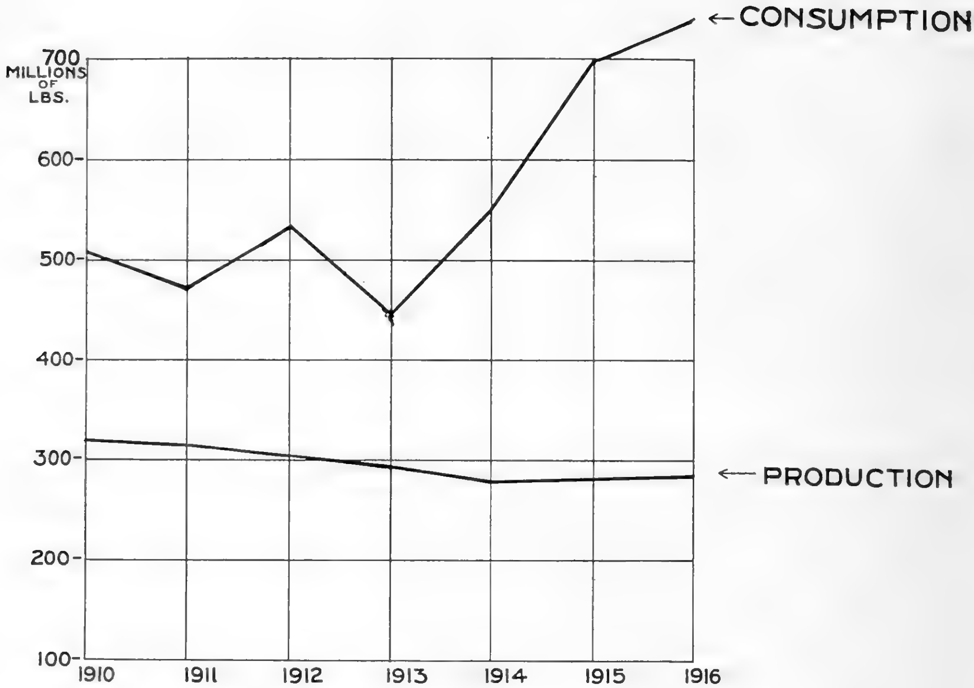
The breed of the future is a breed which combines meat production and wool production in due degree, and which can be raised on the farm as a feature of mixed farming. The Down breeds of England meet this need for the eastern United States; in the West a new breed may have to be created, if it has not been supplied by the hybridizers of New Zealand, in the Corriedale.[1]

SHEEP ON THE FARM

In Great Britain large numbers of sheep are raised on waste land, which is too rocky or unproductive to be plowed. In the United States such land is allowed to lie idle, overgrown with brush, or is perhaps used as pasture for other animals which are able to derive little nourishment from it, not being close-croppers like the sheep, nor able to assimilate so much roughage. The American farmer must be depended on to build up the industry which the American rancher is allowing (willy nilly) to decline. And the American farmer is coming to realize this—coming so rapidly that he has forced the price of breeding ewes up 300% in half a dozen years.

Last year a new homestead act was passed by Congress which will permit applicants in the sheep country to file on 640 acres for grazing purposes. Obviously this means that many of the large ranges will be cut up, and their great flocks of sheep driven out of existence. It was freely predicted that the price of mutton would fall to the ground when the sheepmen began to

[1] See Marshall, F. R. Corriedale Sheep. JOURNAL OF HEREDITY, vii, pp. 88–95, February, 1916.



WHY WOOL IS MORE EXPENSIVE EACH YEAR

The above diagram shows that the production of wool in the United States is slowly diminishing, while the amount of it used is rapidly growing. It is, therefore, inevitable that clothing should be dearer. The situation is aggravated by the fact that the production of wool is decreasing in most other parts of the world, where the large areas that formerly supported flocks of sheep are being plowed under. (Fig. 1.)

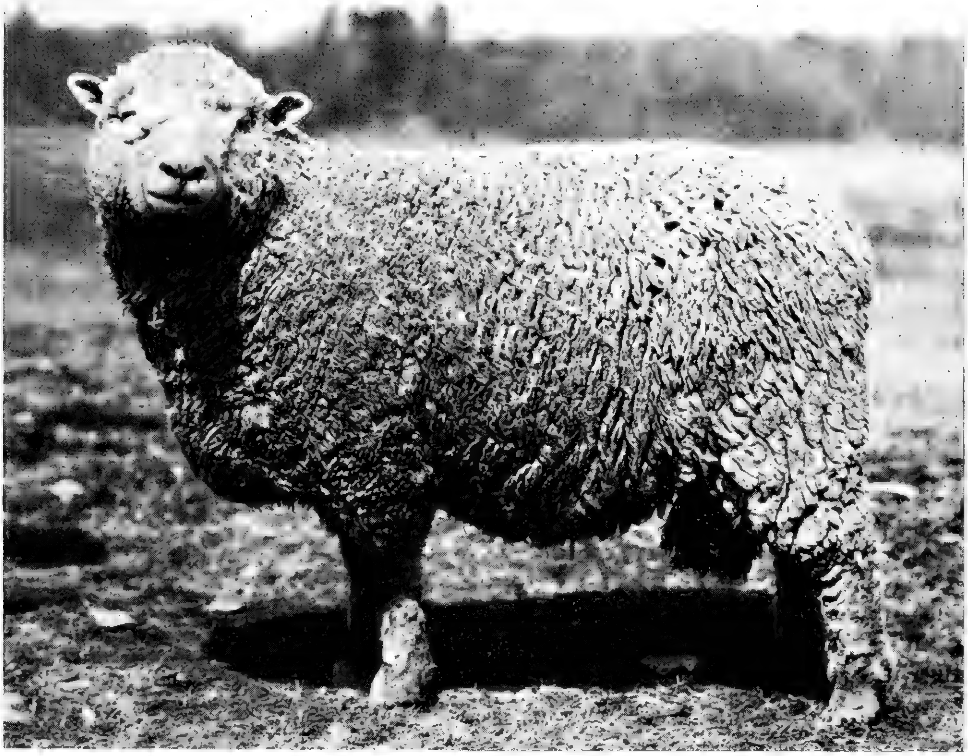
disperse their flocks. But the price has held firm. Many sheepmen, indeed, have been forced to ship their stock east, but it has not reached the stockyards—it was bought up, in large part, by the farmers of the middle west for breeding purposes. The farmers of the east and south have not yet been able to get many sheep, but are ready to buy more as fast as sheep can be grown.

Considering the advantages of sheep on the farm, it seems odd that they should have been universally neglected in the United States, so that only one farm in a dozen has any. The reasons are numerous. Shepherding is a specialized branch of the animal husbandry, which requires skill; few American farmers understand it. Those who did keep sheep confined them to small areas of ground, which in a few years became infested with deadly parasites. And the ubiquitous farmer's dog has always been an enemy of sheep

The first difficulty can be overcome by education in the agricultural colleges. Stomach worms can be avoided if sheep are moved around from one piece of ground to another, after a few years, and if the lambs are marketed early. Dogs can be suppressed. Middle western and other States which are trying to encourage sheep-raising are taking vigorous action against the dog nuisance, and baying the moon may soon become merely a tradition. Iowa has passed a sort of curfew law which provides that owners of dogs must keep them tied up at night, while Illinois has given the sheep raiser authority to shoot any dog he finds on his land, the owner of the dog having no recourse whatever.

THE MOST VALUABLE BREEDS

By such means sheep raising can be reëstablished on American farms. Its



A BREED DEVELOPED BY THE ENGLISH SMALL FARMER

In America and other great sheep countries the favorite breeds have always been the fine wool breeds, such as the Merino. These were bred primarily for wool, and mutton was a side issue. They could be handled profitably only in large flocks on great tracks of cheap land. Such range land is disappearing all over the world now, and the fine-wool sheep is diminishing in numbers as a result. The future of sheep breeding in the United States seems to lie in the dual purpose breeds, particularly the Down breeds evolved in England. The Southdown, a 2-year-old ram of which is shown above, is one of the best of these. Photograph from the U. S. Department of Agriculture. (Fig. 2.)

success will depend largely on the skill of the farmer, and on starting with the right kind of sheep. For this purpose, the English Down breeds—Shropshire, Hampshire, Southdown, Dorset and Oxford—and the Tunis breed are desirable. Merinos, the finewool sheep of the western plains, are less desirable for this purpose; if kept, they should be mated with a black-face ram. If he understands what he is doing, the farmer should make the meat pay the entire expense of maintaining the sheep, leaving the wool as clear profit.[2] No other animal, it is claimed, can be handled with as little labor and expense, and as large returns in proportion to the investment.

One of the incidental advantages which may be of great value is the destruction of weeds. In some of the eastern States, a large part of the pasture

[2] Lambs are now worth about $13 per hundredweight "on the hoof." Clipped wool brings from 50 to 70 cents a pound, and an average sheep yields 8 pounds a year. The number of sheep over one year old in the United States is about 35,000,000 and the annual slaughter about 13,000,000.

AFTER THE CLIP

To the untrained eye, a sheep is not under any circumstances a beautiful animal, unless when seen at a distance as part of a landscape. But the sheep which has just been shorn is, perhaps, even less attractive, esthetically, than one in the fleece. The sacrifice is financially well worth while, however, for an average sheep will yield 8 pounds of wool a year, which now brings the extraordinary price of 50 to 70 cents a pound. The animal above is a yearling Southdown ram. Photograph from the U. S. Department of Agriculture. (Fig. 3.)

land has degenerated and is so grown up with weeds as to be practically worthless. By ordinary methods this can not be reclaimed profitably. But a flock of sheep will clean up the weeds and grow fat on them, and the blue-grass will follow in their footsteps. The intelligent farmer who starts with even a dozen ewes and allows them to reclaim his waste land will make money. "Sheep stand alone," says F. R. Marshall,[3] "in their ability to yield a quickly-made, marketable article from a maximum of forages. In a single season they can harvest and economically use two immature crops from the same land that ordinarily produces but one seed crop. By manufacturing the plants into meat and wool before they make their greatest draft upon the fertilizing elements of the soil, and by returning thereto the greater part of those elements, the forage-raised sheep are invaluable as conservers of soil fertility and indispensable occupants of land deteriorated or in danger of deterioration by grain-raising."

In short, "the mutton sheep is the most economical of animals for conditions of intensive stock farming."

[3] In an address before the Second Pan-American Scientific Congress.

A HERD OF SHEEP CLEANING UP AN OLD PASTURE

In some of the older States of the Union, much of the pasture land has deteriorated until it has become almost worthless, producing little but weeds. A small flock of sheep will fatten on the weeds, and bluegrass will follow in their footsteps. Even a dozen sheep, properly handled and moved to fresh land every year or two, will be a valuable asset on a farm. The view here shown is in North Carolina. Photograph from the U. S. Department of Agriculture. (Fig. 4.)

The present sensational "boom" in the sheep industry is, therefore, an increase in national assets. Besides furnishing the necessary mutton and wool, it will have several indirect advantages:

1. It will diminish the amount of grain and expensive concentrates fed for livestock, thus leaving more food for the human population.

2. It will reclaim or increase the value of millions of acres that are now lying idle or, as pasturage, are giving little income.

3. It will help to diminish the serious shortage of farm labor, since sheep require less labor than any other important branch of animal husbandry.

THE QUESTION OF PRICES

But will the price of mutton and wool drop?

Probably not in the near future. Meat is in too much demand, and the number of lambs marketed is likely to diminish, as the ewes will be sold for breeding instead of butchering.

The wool market is pretty certain to show a further rise, instead of a fall, until some time after the war. The amount of wool needed for military purposes in the United States is estimated to be equal to an entire year's clip of this country. It is a long time since the United States produced enough wool for its own needs. Imports have been getting heavier each year. As a war measure the British Government placed an embargo on wool exports from its colonies. Although this was raised under certain limitations for some American manufacturers, it left South America the only large, free market, and here great quantities of wool were bought up and stored by Germans, to keep it from reaching their enemies.

From the day America entered the war, it was evident that, in the ordinary

GOOD AND POOR MUTTON TYPES

A valuable leg of mutton can be secured from the ewe at the left, while the one at the right, although costing as much to keep, will yield much less meat. The ewe on the left is of the Southdown breed, one of the best for the small farm. Photograph from the U. S. Department of Agriculture. (Fig. 5.)

course of events, wool would become dearer in the United States. Early in April, a committee of wool merchants, inspired by patriotism, offered to allow the Army to contract for all the woolen cloth it wanted at the then ruling market price. The offer was not accepted; and when, several months later, contracts were finally let for woolen goods it was necessary to pay the current price, which had in the meantime advanced 30%.

The Navy endeavored to avoid "bulling" the market by contracting for as much wool as it needed in Australasia, and offering to deliver it to American manufacturers, to be turned into cloth at a fair profit. The arrangement seems to have worked well.

But nothing is likely to prevent further increase of the cost of wool; and it is noteworthy that clothing manufacturers are among those who are trying most actively to stimulate sheep-raising, in some of the middle western States. They reason that if woolens become

ONE DRAWBACK TO THE SHEEP INDUSTRY

Dogs have always been an enemy of sheep, and have made the industry unprofitable in many regions. But with the present "boom" in sheep breeding, many States are trying to end this nuisance. Illinois now gives the farmer the right to shoot any dog he finds on his land without asking any questions. With extension of such legislation, scenes like the above, showing the result of a night's carnival by the neighbor's dogs, will no longer be possible. Photograph from the U. S. Department of Agriculture. (Fig. 6.)

much more costly, men will not buy new suits so frequently, and the clothing industry will, therefore, suffer.

Besides the clothiers, so many other interests will be benefited by a more widespread sheep industry, that a "boom" is not surprising. If it is guided wisely, it should make the sheep as much a feature of mixed farming as is the cow, pig, or hen.

Studies in Animal Behavior

STUDIES IN ANIMAL BEHAVIOR, by S. J. Holmes, Ph.D., associate professor of zoölogy, University of California. Pp. 266. Boston, Richard G. Badger Co., 1916.

The manifestations of instinct and intelligence in animals have a widespread interest, but popular accounts are likely to be highly unscientific; and this is even more true of popular accounts of the evolution of intelligence. So scholarly and readable a volume as that of Dr. Holmes is therefore of particular value. He surveys a wide field, from detailed studies of tropisms to the evolution of parental care, the recognition of sex, and "the mind of a monkey." Instinct is universal among animals but intelligence, which he defines as "the power of forming associations, or associative memory" has its beginnings very far down in the scale, and is a development of instinct. No matter how much developed the intelligence is, instinct still furnishes the fundamental springs of action, even in man.

THE YOUNG MOTHER

Alexander Graham Bell's Investigation Shows Her Age Has a Marked Effect on the Vitality of Her Children—Infant Mortality Increases Steadily as the Mother Grows Older—From This Point of View Girls Ought not to Delay Marriage beyond the Age of Twenty-five

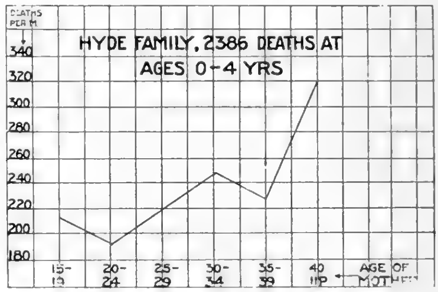
THERE is a growing tendency among women of the most intellectual type to postpone the age of marriage and motherhood. Whereas most women marry between 20 and 25, graduates of women's colleges most frequently marry between 25 and 30. Miss M. R. Smith calculated[1] the average age at which college alumnae wed, as 26.3 years. This means that to offset the considerable number who marry as soon as they graduate, there are many who do not marry until the age of 30 or after.

Feminists without adequate scientific training have attempted to justify this course, and have tried to create an impression that the children of young mothers are in some way inferior, while the best children are those born to women who have reached a certain maturity. In much of the recent periodical literature due to radical feminists, there is a tendency to suggest, if not to declare, that it is to the advantage of both mother and child that women should not undertake the duties of maternity too early.

TABLE 1

Age of mother when child was born	*Total No. of children born*	*No. who died under 5 years of age*	*Child mortality, rate per thousand*
15–19	70	15	214
20–24	454	88	194
25–29	603	133	220
30–34	561	140	249
35–39	422	98	232
40 and upward	274	88	321
Total......	2,384	564	

Whether or not there are social reasons that make late marriage desirable for girls, will not here be discussed. But as for biology, every eugenist knows of the abundant proof that relatively early marriage is beneficial both to mother and to child.[2] One of the proofs is furnished by a study of infant mortality in relation to age of mother.



INFLUENCE OF MOTHER'S AGE

Those children show the greatest vitality who were born to mothers between the ages of twenty and twenty-five. Children born after the latter age are increasingly penalized. The total of 2,386 is erroneous; it should be read 2,384. (Fig. 7.)

Alexander Graham Bell has recently completed an investigation of the longevity of members of the Hyde family in the United States.[3] They represent an intelligent, prosperous, old American stock; most of the births in the genealogy fall between 1750 and 1825. Table I and Fig. 7 show the child mortality and the age of mother when the child was born. In general, it is evident that a child's chance to survive the diseases

[1] *Quarterly Publications of the American Statistical Association*, March-June, 1900. Miss Smith noted that marriages under twenty-one were becoming more frequent among noncollege women, while marriages after thirty-four were growing in number among college graduates.

[2] A large amount of evidence from European sources was published by Corrado Gini in Vol. ii of Problems in Eugenics (London, 1913).

[3] These data are published in Vol. ix of the *Beinn Bhreagh Recorder*, a copy of which is on file at the Smithsonian Institution, Washington.

and dangers of the first four years depends quite directly on the age of its mother. The death rate for children of the oldest group of mothers is about 50% greater than that of the children of young mothers.

The mothers under 20 years of age appear to form an exception. At first sight, the higher death rate of their children seems to indicate clearly that too early maternity is a disadvantage. Without denying this possibility there are several considerations which make it seem probable that these youngest mothers form an exception more apparent than real to the general biological rule: the younger the mother, the better the child's chance. It is possible that the higher death rate in the children of this group is partly due to the juvenility and inexperience of the mothers, and not to their physical unfitness for marriage. This explanation cannot be pushed any farther, as has sometimes been done, to claim that all infantile mortality depends more on the intelligence and training of the mother than on her age; for in such a case the death rate ought to be lower with each added year of the mother's age—a supposition exactly contrary to fact. The higher death rate in this first group may also be due in part to the fact that the children involved are practically all first-born, for whom the death rate is well-known to be higher than for those who immediately follow them. In the other groups of mothers, the first-born children are swamped by the later-born, and the effect of their presence is not so evident as for the group of mothers 15–19, practically all of whose children must be first-born. This is a biological matter, but not one which offers any reason for postponing maternity; since if a woman is going to have children at all, one of them must be first-born.

If these two suppositions are well founded, then the death rate of children born to mothers 15–19 does not necessarily prove, at least to such an extent as one might think, that the mothers were physiologically too young when they married.

The other facts in the table are self-explanatory. While the evidence cannot be considered wholly satisfactory, until data are available which take account of the order of birth of the children, and the intervals between births, as well as the age of the mother at birth, yet the general conclusion to be drawn is clear. The children of young mothers have the greatest vitality, and every added year of the mother's life is a handicap to her next child.

Table II

Mortality Rate per 1,000 Births among Infants Included in Three Investigations, Classified According to the Age of Their Mothers

Age of the mother	*Number of births*	*Infant mortality rate*
Boston (Mass.) Investigation		
All ages	2,025	125
Under 21 years	145	90
21 to 25 years	559	109
26 to 30 years	573	131
31 to 35 years	440	132
36 to 40 years	241	149
Over 40 years	67	164
Fall River (Mass.) Investigation		
All ages	746	202
Under 20 years	29	103
20 to 29 years	386	189
30 to 39 years	257	206
40 and over	36	222
Unknown	38	...
Johnstown (Pa.) Investigation		
All ages	1,463	134
Under 20 years	95	137
20 to 24 years	454	121
25 to 29 years	391	143
30 to 39 years	449	136
40 years and over	74	149

There is plenty of confirmatory evidence. Three studies of infant mortality in America[4] are presented in Table II. For comparison with Table I, it should be noted that these tables deal only with the first year of the child's life, while

[4] The Boston study was made by Hibbs and others of the Boston School for Social Workers, in 1910–12, and is quoted from Hibbs, Henry H., Jr., Infant Mortality. New York, Russell Sage Foundation, 1916. The other two tables are cited from Hibbs after:

Dublin, Louis I. Infant Mortality in Fall River, Massachusetts. *Quarterly Publications of the American Statistical Association*, n. s., No. 110, June 1915.

U. S. Children's Bureau. Infant Mortality: Johnsontown, Pa. Washington, 1915.

Alexander Graham Bell's study carried the child through the first four years. The general trend of the evidence is the same in all cases, and in two of them the mothers under twenty make a better showing than any others. Differences in race and social status in various cities are so great that any exact comparison would be unprofitable. It is only desired here to insist on the uniform trend of the statistics, which indicate very clearly one of the dangers of delayed marriage.

The uniform trend of the data precludes the idea that the death rate is more influenced by the mother's intelligence than her age. It might be, however, that it is largely influenced by poverty. In this view the young mothers would succeed better with their children because they had only a few to care for; while the mothers at the age of 35 to 40 had already large families and too little income to provide the new arrivals with the necessary care. This argument doubtless holds good to some extent in the slums, but it can hardly carry much weight in the Hyde family, which seems on the whole to have been fairly well-to-do. If both these influences (increasing experience and poverty of mother with added age) were at work, they would tend to neutralize each other, thus leaving the actual results to be attributed to physiological factors connected with the age of the mother.

In sum, it seems clear that the age of the mother at the birth of her children has a marked influence on their vitality; that as measured by infant mortality the best age for a girl to marry is probably between 20 and 25; and that every year a woman delays childbearing after the age of 25 is penalizing her children.

The Manchu Emperor K'ang Hsi as a Plant-Breeder

One of the earliest examples of successful breeding of a pure line, that is, a uniform strain descended from a single plant, appears to be furnished by the Manchu emperor K'ang Hsi, who reigned 1662–1723. The story (which, of course, requires authentication) is translated by E. R. Huc from the emperor's own memoirs, as follows:

"I was walking, on the first day of the sixth month, through some fields where rice had been sown which was not expected to mature until the ninth month. I noticed, accidentally, one rice plant which had already headed out. It was much taller than any of the others and was sufficiently ripe to be plucked; I had it brought to me. The grain of this head was well formed and developed; this gave me the idea of saving it and planting it, in order to see if it would retain its precocity the following year; in effect, it did retain it. All the heads which appeared ripened before the usual time and were ready for harvest by the sixth month. Every year has multiplied the produce of the preceding year, and for thirty years it is the rice which has been served on my table. Its kernel is elongated, and slightly reddish in color; but it is of a delightful odor, and of a very agreeable savor. It has been named 'yu-mi,' imperial rice, since it was first cultivated in my gardens. It is the only variety which will ripen north of the great wall, where the cold stays late and comes extremely early; and in the south, where the climate is more mild and the ground more fertile, two crops a year are easily raised. It is indeed a sweet consolation to me thus to have procured this advantage for my people."

Huc (*L'Empire Chinois, t. ii*) further states that the rice is particularly adapted to semi-arid regions. This variety of rice, if it exists, has apparently not been introduced to America. Cereal experts have heard of a Manchurian rice which corresponds in many ways to K'ang Hsi's description, but it is held in such esteem by its growers that they have been unwilling to part with any seed.

ANCESTRY OF THE CAT

Tabby an Animal of Mixed Blood—Egyptian Wild Cat Probably First Domesticated and Has Crossed with Other Cats in Many Lands to Which It Was Taken by the Phoenicians

ALTHOUGH the popular opinion supposes the house cat to be simply a domesticated European wildcat (*Felis catus*), which formerly inhabited all of Britain and ranged over the continent from Greece to Scandinavia, it seems probable that "tabby" cannot trace its descent entirely from one wild species. The breeding, selection and domestication of the cat have been the object of much thought for thousands of years.

The probable ancestor of most domestic cats is a yellowish cat with tiger stripes, *Felis libyca*, which still roams about Northeastern Africa, hunting mostly at night and living in holes dug by other animals.[1] The African cat is but slightly larger than the domestic cat, and often marked quite similarly, although the coloring is usually lighter and more tiger-like than that of the "tabby." There is no more differentiation, however, than often appears between house cats living in the same block of a city street.

Some thousands of years before the advent of the Christian era, Egypt was a land of storehouses overflowing with the rich produce of the fertile Nile valley. Rats and other rodents found no food so available and no shelter so safe as that furnished by the Egyptian granaries. It is probable that the first attempts at domestication of the cat occurred when specimens of *Felis libyca*, which abounded in the region, were caught and locked up in the grain houses to catch vermin.

Appreciating the importance of such a protection to the produce of the land, the wily priests soon established the cat as a sacred animal, which was to receive every attention from the totemistic inhabitants. Temples sprang up in honor of the cat-goddess Pasht, from whose name some think the word "puss" is derived, and cats were mummified with as much ceremony as were men and women. The members of a family which lost a cat by death shaved their eyebrows and went into deep mourning. A cemetery was recently discovered at Bubastis which yielded several hundred thousand cat mummies, many of them preserved with elaborate care. The present inhabitants of the country took sufficient interest in the feline remains to dispose of them as fertilizer at $15 per ton.

Perhaps the next nation to become interested in the newly domesticated animal was Phoenicia. The hardy seafarers must have been greatly troubled with rats aboard their ships, and found the cats a help in protecting the pantry. In their travels the Phoenicians evidently took the Egyptian cats to all parts of the then known world, so that many species of wildcats now existing along the Phoenician trade route are believed to be the feral descendants, either direct or crossed with indigenous cats of the locality, of the Phoenician rat-killers.

The Greeks probably had no cats. The *ailuros* which they kept on board their ships for killing rats seems to have been the white-breasted martin (Mustela), although the word "cat" is frequently though erroneously used in translating the Greek term. But the Romans evidently possessed them, and it is probable that from Rome they

[1] This cat is also known under the names of *F. caffra*, *F. obscura*, *F. nigripes*, *F. maniculata*, *F. pulchella*, *F. chaus*, *F. caligata*, *F. margarita*, *F. inconspicua*, *Chaus caffer*, *Leopardus inconspicuus*, etc. The above names are sometimes applied to other cats than the Egyptian wildcat, but since all the small wildcats interbreed freely, it is difficult to draw any line in nomenclature. The house cat passes everywhere under the name of *F. domestica*.

THE ANCESTOR OF THE HOUSE CAT

Although the common house-cat of Europe and America is very much of a mongrel, its pedigree can always be traced back to a wild African cat, a specimen of which is shown above. This one, which is only half-grown, was kept as a pet by natives of the northeastern Uele district, Belgian Congo, and was photographed by Herbert O. Lang, of the Congo Expedition, American Museum of Natural History (New York City). It is supposed that this species was first domesticated by the Egyptians and then secured by the Phoenicians, who are thought to have taken it with them on their travels and thus dispersed it very widely. (Fig. 8.)

were carried northward. As soon as the domestic breed became established in Europe it began to cross and still does cross freely with the European wildcat (*Felis catus*). It is probable that the cat was brought by the Romans to Britain some time before the fifth century, although the first mention of its existence occurs in the laws of the Welsh prince Howel Dhu, which were enacted about the middle of the tenth century. It seems possible that the European wildcat and Egyptian cat were of much closer relationship than has been supposed, since fossil feline remains found in Britain bear just as much resemblance to the Egyptian cat as they do to the native wildcat of the present day.

From the crossing of the imported Roman cats and the British wild cat evidently resulted the modern "tabby." But the Angora comes from another source. Just what this source was is not positively known, but it seems probable that a cat of Central Asia (*F. manul*), popularly known as Pallas' cat,[2] is the ancestor of the Angora and

[2] Peter Simon Pallas, 1741–1811, was a German by birth and parentage, but did practically all his notable work in Russia and is hence often classed as a Russian naturalist. He was the son of a surgeon in the Prussian Army and himself studied medicine, but early developed a bent for natural history and at 23 years of age was made a foreign member of the Royal Society. By personal invitation from the empress, Catharine II, he occupied the chair of Natural History at the Imperial Academy of Science in St. Petersburg. He spent a year in England studying geologic conditions there, and was then appointed naturalist to a Russian scientific party which made a trip through Russia and Siberia. During the six-year trip he went by Kasan to the Caspian Sea, spent some time among the Kalmucks, crossed the Urals to Tobolsk, visited the Altai Mountains, traced the Irtesh to Kolyvan, went to Tomsk and Yenisei, crossed Lake Baikal, and explored the frontiers of China. His records of this trip form one of the most interesting chapters in natural history. He was given a magnificent estate in Crimea by the empress on his return, where he lived until the death of his second wife, then removing to Berlin, where he spent the last year of his life.

Persian breeds of today. Pallas' cat has long, soft fur of a light whitish-grey color, and a short ringed tail, and is slightly smaller than the Egyptian cat. It may be supposed that careful crossing and selection lightened the color of the hair still further, and eliminated the conspicuous rings from the tail.

In every country to which the Egyptian cats were taken, crossing probably took place between the newcomer and the indigenous cats already inhabiting the locality. A great number of variations would thus be continually produced, and hence the domestic cat is, properly speaking, not a true species but a "convergent species" or an aggregate of crosses between the Egyptian cat carried by the Phoenicians and the wild cats of every country where the Egyptian cat was taken. This accounts in part for the wide variation to be seen among modern cats. The rest of the variation seems to be due to mutations.

But We Are Not Yet Devoid of Hope and Cheer

THE FURTHER EVOLUTION OF MAN, a study from observed phenomena, by W. Hall Calvert, M.D. Pp. 324. London and New York: Fleming H. Revell Co., n.d.

"The palmy days of heredity are over," says Dr. Calvert. Its "dead hand" can no longer restrain the progress of what he calls "genus homo sapiens." The idea of natural selection Dr. Calvert has likewise "absolutely confuted: and it is fortunate for the race that this awful doctrine has been destroyed, otherwise the only possible fate of man was one of despair and devoid of hope and cheer."

But Dr. Calvert (who owes many of his ideas to "association with the fine intellectual vigor and acumen of the minds of the Shakespeare Club of Melrose") is not the man to tear down a noisome hovel without erecting in its place a splendid temple, four-square to all the winds that blow. He recognizes that there must be some check on the increase of population; what is it if not natural selection? What else but "Paulin's law of the cannibal habit of the male"? The reason that the numbers of a species do not perceptibly increase is because the father eats the surplus offspring as fast as they are produced. This accounts for the stability of species among the carnivora and also, Dr. Calvert declares, in that class of animals which shortsighted naturalists have been calling herbivora; but it does not apply to "genus homo sapiens;" and the author takes this occasion to point out to men of so-called science the folly of trying, as they do, to make one explanation fit too many cases. The check on increase of human population is something quite different, namely, the supposed fact that a man does not marry if he is out of a job.

So much for the "now exploded hypothesis" of Darwin and Malthus. It follows that the "survival of the fittest" is a delusion; instead there is the "survival of the average," due to the supposed swamping effects of sexual reproduction on any new character. All that an animal inherits is the general species-heredity; everything else is due to the environment. It passes belief that professed scientists should have failed to recognize the importance of the environment, when "all the religious bodies of the world understand the power which environment gives them in maintaining and increasing the numbers of their respective creeds"!

From this point "we are carried back, through the force of pure reason, to the argument of design, having its origin in a great First Cause, which alone has given laws to matter, method to the universe, and life upon the earth."

The progress of science requires that all its doctrines, such as natural selection, should receive constantly the most severe criticism possible. But it is rarely nowadays that a reputable publishing house issues a treatise on evolution by a man who knows as little about evolution as does Dr. Calvert.

THE PARENTS OF GREAT MEN

Report on Data Submitted in Response to Offers of C. L. Redfield—Hypothesis that Talent Is Inherited only as a Result of Excess Work Done by Ancestors Is Not Supported by Facts

IT IS the general belief of men of science that parents cannot transmit their education to their children, by the process of biological heredity. The child is the product of the parents' germ-plasm, and no way is known by which the reading and study of the parents could so affect their germ-plasm as to change the mental capacities of their offspring. The child, it is supposed, inherits only the inborn, germinal traits of his father and mother, and is unaffected by those which his parents acquired, whether they be physical, as scars or sunburn, or mental, as a knowledge of Sanskrit.

But this general belief is not accepted by C. L. Redfield, a Chicago engineer. He is convinced that

> Educating the grandfather helps to make the grandson a superior person. . . . We are, in our inheritance, exactly what our ancestors made us by the work they performed before reproducing. Whether our descendants are to be better or worse than we are will depend upon the amount and kind of work we do before we produce them.

Mr. Redfield reached this conclusion through the study of pedigrees of men and various other animals, which seemed to show that superior individuals were always born late in the life of their parents, or at least, that they represented several generations of slow breeding. He reasoned that this excess time must mean that the parents had done excess work before reproducing, and that the offspring were superior because they inherited the effects of this excess work.

A theory so antagonistic to the accepted view of heredity naturally made little headway among biologists. With a view to securing evidence which might be more convincing, Mr. Redfield asked the American Genetic Association to publish an offer on his behalf, and this offer has been open for about three years. As revised and expanded a year ago,[1] it read as follows:

1. He will pay $200 for evidence that any one of the two or three thousand intellectually great men or women of history is the product of an ancestry which represents, on the average, four generations to a century.
2. He will pay $200 for evidence that any one of the two or three hundred intellectually *very* great men or women of history is the product of an ancestry which represents, on the average, three generations to a century.
3. He will pay $200 for a case from livestock breeding, where the parents made acquirements below the standard, in respect to performance, and the offspring surpassed the parents.
4. He will pay $200 for a case where a decline in powers of the offspring failed to follow acquirements, in the parents, which were clearly and distinctly below the standard of performance of the breed.
5. He will pay $200 if it can be shown for any group of animals that the amount of improvement or decline in animal powers was not, as nearly as can be determined by actual measurements, exactly proportional to the amount of acquirement by ancestors above or below the normal or standard.

This offer expired on December 31, 1916, and the results are presented herewith.

NO COMPLETE HUMAN PEDIGREES FOUND

A number of pedigrees of great men have been submitted, which show rapid breeding; but none of these is complete to the extent of including all ancestors for three generations. Thus none of them meets Mr. Redfield's requirement.

[1] JOURNAL OF HEREDITY, vii, p. 286. Previous articles dealing with the subject are in this JOURNAL, Vol. vi, p. 157, p. 249, p. 254, p. 487; Vol. v, p. 316

This failure is not due to the lack of diligence on the part of correspondents,[2] some of whom have devoted much time to the study; but to the inadequate genealogical material available about great men. It is a noteworthy fact that Mr. Redfield himself, who has published hundreds of fragmentary pedigrees of great men, showing rapid or slow breeding, has not in a single instance, so far as the writer knows, published a complete pedigree for three generations, such as his offer required.

While none of the pedigrees was technically acceptable, in competition for Mr. Redfield's money, some of them are of interest.

ABRAHAM LINCOLN

The ancestry of Abraham Lincoln was long shrouded in doubt, to such an extent that his birth was widely alleged to have been illegitimate. The supposed inferior character of his forebears has long been a stock case for citation by those who "don't believe in heredity," and who pointed to Lincoln as a great man who had come from a most unpromising stock, in defiance of all the laws of inheritance of mental qualities. Mr. Redfield, misled by inaccurate accounts, has cited Lincoln as the product of exceptionally slow breeding, and would account for his preëminence in this way.

But recent researches[3] have taken all the mystery from Lincoln's parentage and shown, as Ida M. Tarbell puts it, that he "inherited from his ancestry traits and qualities of mind which made him a remarkable child and a young man of unusual promise and power. So far from his later career being unaccounted for in his origin and early history, it is as fully accounted for as is the case of any man." The Lincoln family was one of the best in the United States, and its men had made a uniformly good record, in various parts of the country, for nearly two hundred years prior to his birth. His father, Thomas Lincoln, while eccentric, was a man of remarkable character in many ways, by no means "poor white trash" as popular tradition describes him. The family of Nancy Hanks, Abraham's mother, was likewise one which showed a high level of mental and moral qualities. Moreover, Thomas Lincoln and Nancy Hanks were cousins. Miss Tarbell is quite right in saying that Lincoln's abilities were the natural product of his ancestry.

While the names of all his ancestors on both sides, for four generations, are known, many of the dates are uncertain and it is impossible to say definitely to what extent reproduction in this family was earlier or later than usual. Thomas Lincoln was thirty-one and Nancy Hanks twenty-five, at the time Abraham was born, both these ages being under the average for old American families. It is known that Samuel Lincoln, Abraham's ancestor of the sixth remove, was born in 1620; hence for this one line of descent, the "tail-male,"[4] the average of six generations is 31.5 years, well below the average of mediocrity, whereas on Mr. Redfield's hypothesis it might have been expected to be above. The case of Lincoln, while not complete enough to bear much weight, is as far as it goes opposed to Mr. Redfield's hypothesis.

The exact determination of an average[5] length of generation is naturally

[2] Thanks are due to the following, for their research: E. N. Bacon, Chelsea, Vt.; Dr. Anna E. Blount, Oak Park, Ill.; Dr. J. G. B. Bulloch, Washington, D. C.; J. Clarke, Leonia, N. J.; H. L. F. Gillespie, Manchester, Iowa; Dr. Heinrich C. Keidel, Columbus, Ohio; Marshall Nevers, Brooklyn, N. Y.; Dr. A. J. Rosanoff, Kings Park, L. I.; Elizabeth A. Sourdry, St. Louis, Mo.; W. I. Varner, Athens, Ga.

[3] Tarbell, Ida M. *The Early Life of Abraham Lincoln.* New York, 1896. Hitchcock, Caroline Hanks. *Nancy Hanks.* New York, 1899.

[4] From the genealogies of New England families, Mr. Redfield calculates the average length of one generation to be 33.83 years; of two generations, 65.26 years; of three generations, 96.5 years. The "tail-male" is the line of straight descent from father to son: in human pedigrees it is the line that bears the family name.

[5] An average is often merely a device for obscuring the truth, and in any serious study it is necessary to know the deviations from the average as well. Sufficient attention has never been given to the problem of determining the length of a human generation in various countries; it might well occupy the time of some unemployed statistician.

the first step to be taken in this discussion, and one to which Mr. Redfield has not given sufficient attention. He has calculated the length of *paternal* generation in old American families as 33.83 years, and given this universal application. The average of the generations of the two sexes is the correct measure for this purpose. From a more extensive compilation of data by Alexander Graham Bell, on marriages in the Hyde family of America,[6] the length of a paternal generation appears to be 35.4 years and of a maternal generation 33.1 years, giving an average for the two sexes of 33.2 years. By whatever standard, Lincoln's ancestry, as far as known, is found to represent rapid breeding.

FREDERICK II, "THE GREAT"

Frederick the Great of Prussia was born in 1712 when his father was 24 and his mother 25 years old. The ages of his four grandparents were 31, 20, 27 and 21, a remarkable record. His four great-grandfathers furnish the ages 37, 39, 31, 42. His great-grandmothers have not been mentioned by any of the correspondents; if their ages were learned they might easily be found low enough to bring the whole pedigree within the scope of Mr. Redfield's offer. Frederick the Great was admittedly a man of remarkable talents but as his pedigree was not submitted in a complete form, this association is spared the embarrassment of trying to decide exactly how great he was. He remains, nevertheless, as a real difficulty for Mr. Redfield's hypothesis.

WILHELM II, "THE GOOD"

The pedigree of William II, the present Kaiser of Germany, is the most complete received. It lacks only one great-grandmother of being complete for three generations, and shows a remarkable record of rapid breeding. If it be supposed that this missing grandmother was of the same age as her husband (she is more likely to have been younger than older), the average length of the three generations in Wilhelm's ancestry is only seventy-nine years. What an exceptional record this is, can only be appreciated by genealogists who have sought other cases where three generations were compressed within so short a span of years. It would be hard to duplicate. Considering Wilhelm's present position on the world's stage, it is fortunate that the missing great-grandmother relieves this Association from the necessity of deciding how great a man he is. His admirers may look on him as a striking refutation of Mr. Redfield; his despisers will take the opposite view. As Wilhelm married young, the case may be made still more striking by extending the genealogy to his son, the present Crown Prince.

Various figures indicate that the average length of a generation in Prussia is considerably greater than it is in New England. The average age at marriage is given by Mulhall (Dict. of Statistics) as 29.7 for men and 27.1 for women. It is generally calculated by those who deal with vital statistics that the average mother is six years older than the average bride.[7] From this it follows that the average generation in Prussia must be 34 or 35 years, while Frederick's ancestry represents generations of less than twenty-nine years, and Wilhelm's probably about twenty-six.

A careful study made on Mannheim families gives even higher results than the above. Professor Schott[8] took 4,000 families who existed in Mannheim at the beginning of the nineteenth century, and followed them down to the beginning of the twentieth. He found the average difference between the age of a man and his eldest son was $33\frac{1}{4}$ years, between a man and his eldest grandson, $66\frac{2}{3}$ years, between a man and his

[6] Dr. Bell's data are presented in the *Beinn Bhreagh Recorder*, Vol. xix, June 12, 1916. The editor of the JOURNAL OF HEREDITY is alone responsible for the calculation given above.

[7] This holds good in Great Britain and Sweden. In the Hyde family the difference is seven years.

[8] Schott, S. Alte Mannheimer Familien, ein Beitrag zur Familienstatistik des 19. Jahrhunderts. Mannheim und Leipzig, 1910. J. Bensheimer.

eldest great-grandson, 95⅓ years. Knowing the age of the father when his eldest son was born, one can reach an estimate of the father's age at marriage by deducting two years from the age first given. This puts the average age of marriage of men in Mannheim at 31¼ years: the actual figures would be under rather than over this. Adding six years in accordance with custom, it appears that the length of a generation in the male line in Mannheim cannot be much less than thirty-seven years.

HERBERT SPENCER

Herbert Spencer was born in 1820, when his father was 30 and his mother 26. His father's ancestry shows a record of rapid reproduction, five generations of the tail-male averaging only 29 years each. In the mother's ancestry, according to Mr. Redfield, there is indication of slow breeding.

The average generation in England appears to be at least a year shorter than in Prussia.

JOHN STUART MILL

Few of John Stuart Mill's ancestors are known, but his case is worth quoting, because it is great thinkers like Mill and Spencer who, one would suppose, ought to show the most clear-cut evidence for Mr. Redfield's hypothesis, if it were well-founded. Mill was born in 1806 when his father was 33 and mother 24. His father was an eldest son, and his paternal grandmother was the daughter of an 18-year-old girl.

WILLIAM "THE CONQUEROR"

The pedigree of the Norman dukes is incomplete, but it is known that Richard I, "Sans Peur," was born in 933, and that William was born in 1027. This gives 94 years for three generations in the tail-male, a length of time which is below the average for even persons of mediocre intellect.

LOUIS PASTEUR

The length of an average generation in France has been frequently investigated. In Paris of the eighteenth century Fourier and Villot, working independently, found it to be about 33 years for men and 28 for women. Wacher (1882) reached figures two years higher than these. Turquan[9] made a very careful study in 1892, which fixed the generation at that time as 34.8 years in the male line and 29.8 in the female, giving an average generation of 32.3 years.

If a body of thoughtful persons were asked to name the greatest man France has ever produced, Louis Pasteur would probably get more votes than any other. If it were a body of *very* thoughtful persons, the vote would probably be unanimous. Pasteur's ancestry[10] is therefore well worth study.

Born in 1822, he came of a humble stock, his father's family having followed the trade of tanner for some generations, and his mother's that of gardener. His father was a noncommissioned officer in Napoleon's army, a man of much force of character but hardly giving promise of being the father of one of the world's greatest scientists. The father was 31 and the mother probably under 30, when Louis was born. For his paternal grandfather the figure is 22 and for the latter's wife, something less than 20, since she died at that age. The ages of the paternal grandfather's parents were apparently 36 and 30.

Incomplete as it is, it would be hard to find a pedigree offering more objections to Mr. Redfield's hypothesis than does that of Pasteur.

MICHAEL FARADAY

Faraday (born 1791) is one of the few men of science worthy to be ranked with Pasteur. His ancestry is equally remarkable in showing no trace of scholarship prior to the appearance of the one prodigy. His father was a blacksmith, his mother an uneducated farmer's daughter. The age of the former was 30, and of the latter 27

[9] Turquan, V. De la durée de la génération en France. *Jour. de la Soc. de Stat. de Paris* 37 (1896). The other French studies are quoted from Turquan.

[10] The *Life of Pasteur*, by his son-in-law, René Vallery Radot, should be read by every student of biology.

The only other age known is that of the paternal grandfather, 33. Here again, so far as the recorded facts allow one to judge, Mr. Redfield's hypothesis does not appear to fit.

NAPOLEON BONAPARTE

Thanks to the assiduity of hero-worshippers, the genealogy of the first Napoleon has been well established,[11] at least up to the time when the family moved from Italy to Corsica. Not enough of the dates are known to bring it within the scope of Mr. Redfield's offer; but enough of the dates are known to furnish very strong evidence against Mr. Redfield's hypothesis. At the time of Napoleon's birth in 1769, his father was 23 and his mother 19. The maternal grandparents were probably both 27, and the maternal great-grandfather 26. Going back in the tail-male from Napoleon's own father, the ages are 33, 30, 30, 20, 26 and 34, the latter being that of Sebastiano Bonaparte, who was born in 1603 and married Maria Rustelli in 1630. While these figures cover only a part of the ancestry, the dates of marriage of some of the other persons in the pedigree give reason to suppose that they represent the general average. Whether or not one whole-heartedly admires Napoleon, one cannot deny his tremendous talents; and these talents cannot be explained by Mr. Redfield's hypothesis. They fit in well with the accepted views of heredity, however, for the Bonaparte family was one of noble origin, and in every generation had shown ability.

Turquan found the average generation in the male line, in Corsica, to be 35 years, in the female line 31. It is thus evident that, in modern times at any rate, the island is not conspicuous for early marriages, a fact which makes the ancestry of Napoleon all the more striking.

SOME OTHER CASES

Five generations in the tail-male of Julius Caesar's ancestry apparently represent an average of 29 years each. The only date known in the ancestry of H. Helmholtz, who had as great an intellect as was ever made in Germany, is that of the father, who was 29 when his son was born. Leonardo da Vinci, born in 1452, was the son of a 25 year-old law student and a peasant girl. Five generations of ascent in the male line of Charlemagne's pedigree show an average of 33 years. Christopher Columbus' father was 25 at the time the explorer was born. But perhaps no case is more surprising than that of John Napier, inventor of logarithms and a man of immense mental capacity, whose father was 17 and grandfather 24.

Pedigrees such as have been cited above are at least enough to make one feel that Mr. Redfield's hypothesis has many difficulties to overcome before acceptance. But none of the pedigrees mentioned was submitted in such form as to meet the requirements laid down by Mr. Redfield in sections 1 and 2 of his offer.

Of course, the cases just enumerated are selected cases. It is not intended here to deny that great men are most likely to come from families where marriage has been later than the average. These selected cases are presented to show that Mr. Redfield's claim that great men cannot come from any other kind of family rests on an insecure basis. He has never attempted to justify his hypothesis by the only method which would test it—namely, by an investigation of the order of birth of sons in the same family, to ascertain whether the later-born more frequently attain greatness than do the earlier-born.

The production of great men from late marriages is quite what would be expected, on any hypothesis of heredity. Great men usually come from families which have more than ordinary intellect, and in such families, marriage is regularly postponed beyond the average of the race, because of economic and social reasons.

The question of educational influences likewise needs, among others, to be

[11] See *Le Nid de l'Aigle* by Colonna de Cesare Rocca; and *Memoires sur l'enfance et la jeunesse de Napoleon*, par l'abbé T. Nasica (Paris, 1852). The author was juge d'instruccion in Ajaccio 1821–9, where he collected the material for his work.

taken into account. The more aged parent has accumulated more experience, which he can pass on to his children by word of mouth and by example (not, as Mr. Redfield supposes, through his germ-plasm). It may be that the later-born children in a family benefit in a similar way, the father having more often reached an age where he can retire from most active work and spend more time on the training of his children; and farther, they have a distinct advantage in being stimulated to rival their elder brothers and sisters.

These and similar considerations may account in large part for the general fact that great men are the product of late marriages. Whether or not they are wholly sufficient, it is highly unscientific to ignore them utterly as Mr. Redfield does.

Apart from these educational differences, it is not impossible that order of birth is associated with differences of some sort in mental inheritance, as it is with physical inheritance. It is known that the later-born members of a family are more variable in height and weight. It is also known that the earlier born members of a family are longer-lived than are the later-born. On the whole, the younger parents seem to bear the physically better children; it is difficult to believe that there is an antithesis between mental and physical traits, as would exist if Mr. Redfield could prove his hypothesis. The whole problem needs careful study from this aspect.

THE EVIDENCE FROM LIVE-STOCK BREEDING

Mr. Redfield has made use of pedigrees of trotting horses, milk cows and dogs to support his views, and was anxious to secure, through the American Genetic Association, additional evidence from the field of live-stock breeding. The only material submitted under this head is from Lucille H. Cruickshank and G. N. Neagle of the University of Kentucky, who call attention to the brown mare Fereno (born 1897), winner of the Kentucky Futurity as a two-year-old (2:17) and again in the following year (2:10¾). Later she reduced her record to 2:05½. This record places her among a select few of the standard breed.

Her sire is Moko, who has no record, and who was only 3 years of age when he sired her. His training prior to this time is negligible, as he went lame and was sent to the stud instead of the track. Moko's dam and her line of dams were mares of no consequence, so far as performance is concerned, and there is no record of their doing anything on the track. Their value as brood mares is in their possession of the blood of Stockbridge Chief and Hambletonian 10.

Hettie Case, the dam of Fereno, was a good-looking mare, but has no record, and is said never to have been trained. The custom in Kentucky is to allow the brood mares and fillies intended for brood mares to run in the pastures, and they do not get any other exercise than eating blue-grass. After her famous daughter, Fereno, became known, Hettie Case had every opportunity to produce trotting colts to good sires, but her other produce were failures.

The dam of Hettie Case was Rosa Sprague, who was only 4 years old when Hettie Case was foaled. She has no record, and in fact was not a trotting-bred mare at all except on her sire's side, and is recorded as nonstandard. She is said to have had no training.

Moko is living, is noted as a sire of futurity winners, and has a most wonderful record as a sire of fast trotting horses, standing perhaps only second to any living or dead sire of the breed; yet he has not since his three-year-old form, despite all his opportunities in the stud to secure the very best bred mares of the United States, been able to produce a foal that has had the ability to lower the record of Fereno.[12]

[12] This is no longer true. Last year The Real Lady, a daughter of Moko, made a record of 2:04¼. See Wallace's *Yearbook*, Vol. xxxii, p. 623. Up to the time that volume of the yearbook was compiled, Moko was the sire of 132 recorded trotters and 11 pacers.

Fereno 2:05⅓ b. 1897	Moko..... b. 1893	Baron Wilkes 2:18 b. 1882	George Wilkes 2:22 b. 1856
			Belle Patchen 2:30¾ b. 1873
		Queen Ethel...... b. 1885	Strathmore b. 1866
			Princess Ethel b. 1868
	Hettie Case b. 1885	Simmons 2:28..... b. 1879	George Wilkes 2:22 b. 1856
			Black Jane b. 1870
		Rosa Sprague..... b. 1881	Gov. Sprague 2:20½ b. 1871
			Rose Kenney

THE REMARKABLE PEDIGREE OF FERENO

Fereno is a very fast trotter. According to Mr. Redfield's hypothesis, her pedigree should show animals which were worked hard and bred at a late age. The facts shown in the chart above are evidence that a number of her ancestors had no records at all; and if the intervals between generations are counted, it will be found that most of the ancestors of Fereno were bred young. The date of birth of Rose Kenney is not known, but her grandsire, Mambrino Chief, was foaled in 1844. Thus three generations, from the birth of Mambrino Chief to the birth of Rosa Sprague, cover 37 years, and one-third of this is 12.3 years. It will therefore probably not be far wrong to take 12 years as the age of Rose Kenny at the time Rosa Sprague was foaled. (Fig. 9.)

The dam of Fereno had every chance, mated to great sires, to produce something better than Fereno, but instead has produced nothing of great value since then.

The pedigree of Fereno is shown in Fig. 9. Her sire and dam are without records, and only two of her grandparents have records. In earlier generations she has many good ancestors.

The average age of all Fereno's ancestors, compared with the average age of *male* ancestors only of 242 trotters with records of 2:10 or better and of a random group of the first 242 horses in Volume 15 of the Register[13] is as follows:

	Sires	Grandsires	Great grandsires	Great great grandsires
Fereno	7	6.25	14.75	11.27
Average horses	8.28	10.65	11.64	12.78
2:10 horses	9.4	11.5	12.5	13.5

The fact that Fereno's ancestors of both sexes are included in the above table brings an element of uncertainty into the comparison; but on the whole it appears very unfavorable to Mr. Redfield. And the fact that Fereno, a distinctly superior trotter, was produced by an untrained three-year-old stallion, and a brood mare who never before or since produced a superior colt, and who had no record, is very damaging to Mr. Redfield's claims, and seems to justify the contributors in pointing to Fereno "as a clear-cut example to comply with offer No. 3, where the parents made acquirements below the standard, in respect to performance, and the offspring surpasses the parents." However, Mr. Redfield stipulated that the evidence must show the actual amount of training given to the two parents, and as this information cannot be secured, it is impossible to award his money.

[13] Marshall, F. R. The Age of Speed Sires. *American Naturalist*, Vol. xliv, p. 433, July, 1910. The article is a criticism of some of Mr. Redfield's figures.

THE FOUNDATIONS OF MR. REDFIELD'S HYPOTHESIS

This is not the place for a critical examination of Mr. Redfield's hypothesis in detail.[14] But the publicity which the JOURNAL OF HEREDITY has given to his offers might lead someone to suppose that the JOURNAL sympathized with his conclusions; and this would be unfortunate. It is therefore desirable to point out what appears to be the fundamental weakness of his hypothesis. The data which he has accumulated are of value, even though his own interpretation of them cannot be accepted; and it was with the hope of accumulating more data that the JOURNAL OF HEREDITY coöperated with Mr. Redfield.

The Redfield hypothesis, that the parent passes on to his children the effect of his own experience, training or education, may for the sake of convenience be considered here solely in its application to man. It is untenable (1) because it ignores much that has been learned about the mind, and (2) because it ignores more that has been learned about the body.

1. In the light of modern psychology, it is absurd to lump all sorts of mental ability under one head, and to suppose that the father's exercise of reasoning power, for example, will store up energy to be manifested in the offspring in the shape of executive or artistic ability. Mental abilities are much subdivided, and are inherited separately. Mr. Redfield's idea of the process is much too crude.

Moreover, Mr. Redfield's whole conception of the increase of intelligence with increase of age in a parent, shows a disregard of the facts of psychology. As E. A. Doll has pointed out,[15] in criticising Mr. Redfield's recent and extreme claim that feeblemindedness is the product of early marriage, it is incorrect to speak of 20, 30, or 40 year standards of intelligence; for recent researches in measurement of mental development indicate that the heritable standard of intelligence of adults does not increase beyond the age of approximately 16 years. A person 40 years of age has an additional *experience* of a quarter of a century, and so has a larger mental content, but his intelligence is still at the sixteen-year level. Mental activity is the effect, not the cause of mental growth or development. Education merely turns innate mental powers to good account; it makes very little change in those powers themselves. To suppose that a father can, by study, raise his innate level of intelligence and transmit it at the new level to his son, is a naïve idea which finds no warrant in the known facts of mental development.

2. In his entire conception of the storing-up and transmission of energy, Mr. Redfield has fallen victim to a confusion of ideas due to the use of the same word to mean two different things. He thinks of energy as an engineer; he declares the body-cell is a storage battery; he believes that the athlete by performing work stores up energy in his body (in some mystic and undescribed manner) just as a clock stores up energy when it is wound. The incorrectness of supposing that the so-called energy of a man is of similar nature, is remarkable. If, hearing Bismarck called a man of iron, one should analyze his remains to find how much more iron he contained than ordinary men, it would be a performance exactly comparable to Mr. Redfield's, when he thinks of a man's "energy" as something stored up by the performance of work.

As a fact, a man contains less energy, after the performance of work, than he did at the start.[16] All of his "energy"

[14] See Raymond Pearl's review of Mr. Redfield's *Dynamic Evolution* (JOURNAL OF HEREDITY Vol. vi, p. 254): "Like all pseudo-science, Mr. Redfield's is a conglomerate mixture of the true, the false, and the unknown."

[15] Doll, E. A. Education and Inheritance. *Journal of Education*, 85–5, Boston, February 1, 1917.

[16] Atwater's celebrated experiments proved that all the energy (food) which goes into an animal can be accounted for in the output of heat or work. They are conveniently summarized in Abderhalden's *Text-book of Physiological Chemistry*, p. 335.

comes from the metabolism of food that he has previously eaten. His potential energy is the food stored up in his body, particularly the glycogen in the liver and muscles.

Why, then, can one man run faster than another? Mr. Redfield thinks it is because the sprinter has, by previous work, stored up energy in his body, which carries him over the course more rapidly than the sluggard who has not been submitted to systematic training. Such a view is preposterous. The differences in men's ability are not due to the amount of energy they have stored up, but to differences in their structure (using this word in a very broad sense) which produce differences in the efficiency with which they can use the stored-up energy (*i. e.*, food) in their bodies. A fat Shorthorn bull contains much more stored-up energy than does a race-horse, but the latter has the better structure—coördination of muscles with nervous system, in particular—and there is never any doubt about how a race between the two will end. The differences between the results achieved by a highly educated thinker and a low-grade moron are similarly differences in structural efficiency; the moron may eat much more, and thereby have more potential energy, than the scholar, but the machine, the brain, cannot utilize it.

The effects of training are not to store up energy in the body, for it has been proved that work decreases rather than increases the amount of energy in the body. How is it, then, that training increases a man's efficiency? It is obviously by improving his "structure," and probably the most important part of this improvement is in bringing about better relations between the muscles and the nerves. To pursue the analogy which Mr. Redfield so often misuses, the effects of training on the human machine are merely to oil the bearings and straighten out bent parts, to make it a more efficient transformer of the energy that is supplied to it.

The foundation stone of Mr. Redfield's hypothesis is his idea that the animal by working stores up energy. This idea is the exact reverse of the truth. While the facts which Mr. Redfield has gathered deserve much study, his idea of "Dynamic Evolution" need not be taken seriously.

Plant-breeding in Russia

The advancement of genetics in Russia is principally dependent on the Bureau of Applied Botany of the Ministry of Agriculture, which was founded in 1894 and completely reorganized in 1907 on the lines of the American Bureau of Plant Industry. Since 1904 it has been directed by Robert Regel. The bureau's monthly *Bulletin of Applied Botany*, which is published in Russian with abstracts of important articles in English or French, gives (December, 1916) a summary of the work accomplished by the bureau to date, which shows a great deal of fundamental investigation in plant-breeding, as well as attention to the practical problems which are always pressing. It may be added that fifteen of the Russian government's plant-breeders are members of the American Genetic Association.

One of the important accomplishments of the bureau is the translation and publication in Russian of plant-breeding literature. In this way most of the five volumes of Fruwirth's monumental work on plant-breeding have been made available for Russian workers, with many other treatises on special subjects. Mendel's writings and some of those of Baur, Shull and other geneticists have also been translated.

The greatest genetic work of the bureau has naturally been to study the varieties of cultivated plants of Russia, isolating the best pure lines from these for dissemination. The extensive account of this which the *Bulletin* publishes indicates that the work has been of immense value to Russia, and may be of great value to other countries with similar climates.

MUSCADINE GRAPE BREEDING

The Native Grape of the Southeastern United States Has Been Hybridized Successfully with the European Grape—Valuable Self-fertile Varieties Produced.—A New Possibility for the Cut-over Pine Lands of the South

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IT IS a well-recognized fact that cultivated grape varieties derived from the species native to a particular locality thrive under the environmental conditions existing there. The grape varieties best adapted to the hot and more or less arid portions and the higher elevations of the South Central States are those produced by T. V. Munson of Texas, Herman Jaeger of Missouri, and others, from the summer grape, *V. aestivalis*, of the southern Great Plains area. The best grape varieties for the northeastern United States are those, such as Concord, which have been obtained from the northeastern fox grape, *V. labrusca*. The varieties of the river-bank grape, *V. riparia*, thrive in alluvial districts. In like manner the Muscadine[1] grapes, *V. rotundifolia* and *V. munsoniana*, are the proper species for the Southeast because that is their native home. For this reason, in endeavoring to foster grape culture in the Coastal Plain, Piedmont, and Gulf sections of the southeastern United States, the U. S. Department of Agriculture has endeavored to ameliorate the native Muscadine grape rather than to introduce varieties of species known to be ill adapted to the climatic and other environmental conditions.

In their native habitat the Muscadines thrive and produce abundant crops. They do well on lands where other fruits do not succeed, flourishing in poorly drained soils, and warm, humid atmospheric conditions which are detrimental to other species of grape. They have been cultivated for a great many years in the Southeast, but little effort was made until recently to bring about improvement through breeding. Even at the present time the standard commercial varieties are less than six in number and all named varieties are of the *V. rotundifolia* species. These varieties have been named, propagated and disseminated merely because they represented the best that occurred in Nature. Even so, however, they are good grapes, highly prized by the people of the South, who grow them extensively for wine, table, and culinary purposes.

In addition to being native to the Southeast and adapted to soil and climatic conditions there, the Muscadines further qualify as the best grapes for that section by having such desirable characteristics as:

1. Vigorous growth habit.
2. High productiveness.
3. Distinctive and agreeable flavor.
4. Large berries.
5. Late and long blooming period, insuring regular crops.
6. Resistance to diseases and insects.
7. Marked ability to withstand adverse conditions, though responsive to good care.

[1] The Muscadine grapes, which include two botanical species, *Vitis rotundifolia* and *Vitis munsoniana*, are one group of the grape genus. This group is called *Muscadinia*. The other group, comprising the other native grape species and the European grape (*Vitis vinifera*), is called *Euvitis*. The *Muscadinia* is distinct from *Euvitis* botanically in that it has closely adherent bark on the branches, continuous pith through the nodes, unforked tendrils, and flattened seeds with transverse wrinkles on both sides.

A VINEYARD OF MUSCADINE GRAPES

The ground crop is crimson clover. Sometimes sheep are pastured on it, which makes three-story agriculture. The Muscadine grape is a favorite in the southeastern United States where it is native, but offers much room for improvement. Unlike the ordinary grape the Muscadine has been trained high on overhead trellises. (Fig. 10.)

8. Ability to produce profitable crops for 100 or more years.

With such creditable characters, though still a practically untamed branch of the grape family, the Muscadines seemed to offer unusual opportunity for improvement. On the other hand, there were certain difficulties in the way of improvement which the Department recognized from the beginning. For instance, there was not a single known self-fertile variety among the Muscadines, thus necessitating the use of a wild male vine of unknown fruit character in every cross. The only available female varieties were those which had been brought under cultivation and more or less disseminated by persons finding them in the woods and recognizing them as superior to the average wild grape. Nothing was known about the parentage of these varieties and as their distribution had been more or less limited to the vicinity in which they originated their real varietal value had not been established. There were no improved male vines and their need had not been realized, as the importance of providing cross-pollination facilities was unknown.

Such were the conditions when the U. S. Department of Agriculture undertook to improve the Muscadine grape in those ways in which improvement seemed desirable and possible. Apparently these were:

1. Production of improved male vines.
2. Production of self-fertile varieties.
3. Greater productiveness.
4. Increased size of fruit cluster.

TYPES OF MUSCADINE GRAPE BLOOM-CLUSTERS

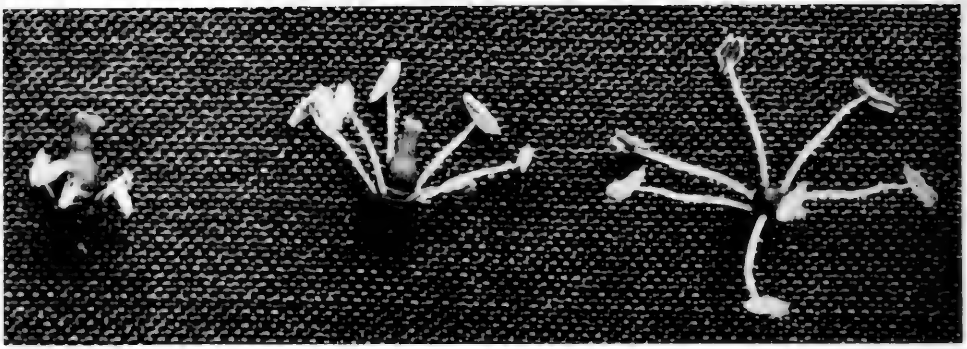
The small cluster on right is typical of the female or, more properly, imperfect hermaphrodite type. All the standard commercial varieties are of this type and the cluster photographed is of the leading variety, Scuppernong. The cluster on left is a typical male or staminate vine cluster. The middle cluster is typical of the new perfect-flowered, self-fertile hermaphrodite type produced by the U. S. Department of Agriculture. Note that it resembles the male cluster in size and shape rather than the female cluster, and that it has erect stamens surrounding a normal pistil in each blossom while the male cluster has no pistils and the female cluster has only short, rudimentary stamens. Photograph one and one-half times natural size. (Fig. 11.)

5. Better berry adherence.
6. Higher sugar and lower acid content.
7. Better pulp quality.
8. Decreased size of seed.
9. Thinner skin of berries.
10. More uniform ripening.

The early surveys showed that the main problem of breeding would be to bring together the desirable characters already present in the two species constituting the Muscadine group, especially *V. rotundifolia*, though it also seemed necessary to go outside of the group for certain other improvements, such as marked alteration of the sugar-acid ratio. The efforts of the Department, therefore, have been, first, to combine and augment in a few varieties the desirable characters now scattered among many varieties of the Muscadines, by cross-breeding and selection work within the species; and, second, to bring about additional improvement by hybridizing with other grape species.

RESULTS FROM INTERCROSSING

In practically every way in which improvement seemed desirable as already indicated, improvement has been secured. Among the more than 5,400 seedling vines produced by the Department there are selected individuals which represent progress toward certain ones of our stated goals and the best of these are being multiplied and thoroughly tested with a view to introducing them eventually as named varieties



TYPES OF MUSCADINE GRAPE BLOSSOMS

At the left is the imperfect hermaphrodite blossom—the so-called female. The male or staminate blossom is at the right, while the new, perfect type produced by the U. S. Department of Agriculture is shown in the center. It will be noted that this new type is a self-fertile hermaphrodite, which produces pollen for its own flowers. Its introduction will do away with the necessity of giving space in a vineyard to male "drone" vines that yield pollen but no fruit. The flowers are photographed about three times natural size on a background of very fine silk. (Fig. 12.)

recommended for planting. Many of these varieties are improved in more than one character.

Intercrossing has been extensively practiced from year to year, the best available fruiting vines being pollinated by the best male seedlings of desirable groups. This work has necessitated most intimate and careful study of the thousands of seedlings produced, in order to be able to select parents intelligently. Certain male vines have become known by their behavior in cross-breeding just as the fruiting seedlings are known by the fruit characters they possess and transmit.

1. *Production of Improved Male Vines*

One of the first results, therefore, from cross-breeding operations has been the obtaining of certain male vines, selected seedlings, which are improved varieties to the extent that they transmit desirable rather than undesirable characters and because they have been selected for vigor, freedom from disease and insect attacks, profuseness of bloom, long period of bloom, and proper time for bloom (*i. e.*, simultaneous with fruiting varieties to be pollinated). These better male vines have, where conditions warranted, already been distributed to grape growers along with fruiting vines to be tested coöperatively in representative sections of the Muscadine territory.

2. *Production of Self-fertile Varieties*

Undoubtedly the most important result of the department's work is the production of self-fertile varieties. It should be emphasized that at the time these investigations were undertaken, there was not such a thing as a self-fertile Muscadine grape. All the fruiting varieties were self-sterile and dependent on insects to bring fertile pollen from the wild male muscadines. The Department now has a large collection of self-fertile varieties.

The value of these self-fertile varieties is evident. (*a*) They are of inestimably great value in breeding work in that they afford for the first time the opportunity to intercross within the species without using as one parent a variety of unknown fruiting qualities (male vine). We can now breed directly for a combination of the desirable characters found in the fruiting varieties of *V. rotundifolia*. (*b*) They afford directly a cluster of increased size (a breeding object) in that the self-fertile varieties are the result of perfecting the large-clustered male type blossoms rather than the small-clustered female type blossoms. (*c*) They afford greater productiveness in that they are able to set

BLOOM-CLUSTERS OF TWO HERMAPHRODITE MUSCADINE GRAPES

At the left is a cluster from the one of the original hermaphrodites, known as H2, and on the right a cluster from H1, the other original hermaphrodite. The good size and proportions of the latter cluster are particularly noteworthy. Photograph about natural size. (Fig. 13.)

as berries from 25 to 50 per cent of the bloom buds, whereas the standard but self-sterile variety Scuppernong, for example, has set at Willard, N. C., under the best natural conditions less than 12% of the bloom buds annually for the last six years, owing to the fact that it must rely on insect cross-pollination. (*d*) The new self-fertile varieties afford opportunity for greater vineyard production as well as vine production, for they can be planted in place of nonproductive male vines as pollinators for female varieties (morphologically imperfect hermaphrodites).

The production of a self-fertile Muscadine grape means the production of a new type of Muscadine grape; one having a new type of bloom which is at once male and female and designated as *perfect* or *hermaphroditic*. This is so important to the industry that a rather full statement seems warranted here in order to show just what has been done.

The Department began its breeding work in 1907. The crosses that year

were made chiefly in a commercial vineyard at New Smyrna, Fla., which contained the largest collection of varieties then in existence and was surrounded by quantities of native vines of *V. munsoniana* and *V. rotundifolia*, the two species constituting the *Muscadinia* group. In the same year, following the Florida work, other crosses were made at several places in Georgia, South Carolina, and North Carolina, where desirable material had been located. The seedlings resulting from this work were propagated in Washington and planted in the experiment vineyard at Willard, N. C., as the first seedling vineyard. Later when these seedling vines began to fruit and bloom, two of them were found to be true hermaphrodites, perfect-flowered, and self-fertile, whereas the other seedlings and all other Muscadine grapes were either staminate or pistillate.[2] The two original true hermaphrodites will be designated as H1 and H2 in the following discussion. H1 was the result of a cross at New Smyrna, Fla., between the standard female variety Eden and a wild, dark type, male, *V. munsoniana* vine. H2 was the result of a cross at Medoc Vineyard, Enfield, N. C., between the standard female variety Scuppernong and a light type male vine.[3] A large number of the seedlings were of the same parentage as the two hermaphrodites but male or female, like other Muscadines. From the two original hermaphrodites other hermaphrodites have been produced, but the Department has failed as yet to produce a third hermaphrodite of distinct parentage.[4]

Of the two original hermaphrodite seedlings, H1 is *V. munsoniana* in type, while H2 is entirely *V. rotundifolia*. The former has small black berries in relatively large clusters while the latter has large light colored berries resembling Scuppernong fruit, though not equal to Scuppernong in quality. The self-fertility of the latter is more pronounced.

Having produced the two original hermaphrodites, the next step was to multiply the type and to transmit the hermaphroditic character to other seedlings. H1 produced a little bloom in 1911. In addition to using this to test the seedling itself (*i. e.*, its pollen, pistils, and fruit), sufficient bloom was secured to pollinate two clusters of Eden, its female parent. This cross yielded two fruit clusters, one of eight berries and one of twenty-two berries, from which 154 seeds were secured. From these, fifty-four seedlings are now living and fruiting. Thirty of these (over 55%) are hermaphrodites and the rest females. Apparently the seedlings which in a normal Muscadine cross would be males are in this case hermaphrodites, or, figuratively, pistils have been inserted in the staminate blossoms making true hermaphrodite blossoms. These seedlings are as a group intermediate between their parents. The best are very prolific, large-clustered, with average-size black berries of good vinous flavor and good quality. They are closely similar and fully equal to Eden and in addition have the hermaphrodite character. The better representatives are being used as parents in the breeding investigations.

After being used in 1911, H1 was

[2] The flower type designated as pistillate or female is morphologically really an imperfect hermaphrodite having rudimentary stamens. There is no true pistillate type of bloom among the Muscadine grapes. The imperfect hermaphrodite bloom, however, behaves as a pistillate rather than as a hermaphrodite.

[3] Male and fruiting vines of the Muscadines are of two types, light and dark, and this color character of the vine is correlated with the color of the fruit. Vines having reddish veins, young tendrils, and growing tips produce dark fruit (pink, red, purple, or black), while vines with light yellowish-green growing tips produce light fruit (yellow, bronze, pearly, or green). The males are classed likewise as indicated by their progeny.

[4] Since this paper was written the third hermaphrodite of distinct parentage has been produced. As it began blooming only recently and has not yet fruited, further reference to it is omitted. It is a vigorous vine of the light type and has set fruit readily under bags. Its pollen germinates vigorously in sugar solution. It has been successfully used to pollinate standard varieties and other hermaphrodites and it has been successfully pollinated with pollen from male and from other hermaphrodite vines. It is the result of a cross in 1913 between two seedling vines in the Muscadine Grape Experiment Vineyard at Willard, N. C.

FLOWERS, GREEN CLUSTERS AND RIPE GRAPES

Clusters picked on October 2 from one of the original true hermaphrodite vines, H1. They show the berry characters, and also show that fruit of all sizes is to be found at one time, from the ripe berry to the blossom. This extends the season of the fruit advantageously. Four-fifths natural size. (Fig. 14.)

killed to the ground during the severe winter of 1911-12, but sprouted and has not since shown injury. Vines propagated by cuttings from it are now fruiting in the varietal collection.

In 1912 sufficient pollen of H2 was available to permit limited crossing, from which one Scuppernong cross, seven James crosses, and five selfed crosses are now fruiting. The seedling of Scuppernong parentage is a female, but subsequent crosses have shown that this was merely chance. Had there been more seedlings produced, some would undoubtedly have been hermaphrodites. Of the seven James crosses, three are hermaphrodites and four females. One of the hermaphrodites is the dark type and very similar to James in fruit quality, while the other six seedlings are of the light type, bearing light fruit. The two light hermaphrodites are much like James in habit, but light-fruited. We thus have not only a hermaphroditic equivalent for James in the dark seedling, but a new type which can be described as a hermaphroditic, light-fruited combination of James and Scuppernong. Of the five self-pollinated seedlings of H2, all are of the light type, all hermaphrodites, all markedly self-fertile, and all very similar to the parent.

In 1913 sufficient bloom was produced on H2 to pollinate the leading varieties and some of our best female seedlings. The object of this work was to produce hermaphrodites so nearly resembling the present leading varieties in fruit qualities as to permit substitution, and also to produce hermaphroditic combinations between the standard variety types. During the season of 1916 the seedlings resulting from this 1913 work began fruiting, and the results, while not all that might be desired, are very encouraging. In addition to some new fruit-type seedlings having the hermaphroditic bloom character, we apparently have now what might be characterized

as James, Scuppernong, Thomas, Eden, and Flowers hermaphrodites. However, as these seedlings are only beginning to fruit, this statement is subject to modification. A full test may show the necessity of working into or toward the different standard varietal types through another generation before practically identical hermaphrodites may be available as substitutes for the present standard female sorts. The following table shows the hermaphroditic results (tabulated June 30, 1916) from crosses in which H2 figured in 1912 and 1913 breeding work.
will be hermaphrodites. These seedlings are chiefly of the third generation, being progeny of hermaphrodite seedlings of H1 and H2 parentage. So far, while it has been possible to self-pollinate H1 and H2, it has been impossible to cross them directly.

3. *Increase of Productiveness*

Increased productiveness is a leading result secured by the Department in its intercrossing work. This has been accomplished in three different ways.

First, it has been possible to gradually increase the standard of productiveness by selecting among the thousands of seedlings those which give evidence of
In 1914 a considerable number of

TABLE 1.—*Hermaphroditic Results from H2 in* 1912 *and* 1913 *Breeding Work, Willard, N. C.*

Year	Parentage (pollen parent stated last)	Total number seedlings	Number hermaphrodites	Number female	Number male	Number not yet tested
1912	H2 ☿ —bagged (*i. e.*, self pollinated)	5	5			
	James ♀ x H2 ☿	7	3	4		
	Scuppernong ♀ x H2 ☿	1		1		
1913	Scuppernong ♀ x H2 ☿	13	4	3		6
	James ♀ x H2 ☿	16	7	7		2
	Thomas ♀ x H2 ☿	15	4	5	1	5
	Flowers ♀ x H2 ☿	13	5	4		4
	Eden ♀ x H2 ☿	27	14	4	1	8
	V16 R6 B2 ♀ x H2 ☿	23	14	7		2
	V47 R9 B2 ♀ x H2 ☿	2	1			1
	V80 R3 B2 ♀ x H2 ☿	2	1	1		
	V21 R15 B2 ♀ x H2 ☿	1				1
	H2 ☿ x V28 R2 B2 ♂	8	1		2	5
	Total	133	59	36	4	34

crosses were made using H2, H1, and the better hermaphroditic progeny of H1. Additional work was done in 1915, but the resulting progeny have not yet bloomed. To date,[5] in addition to the two original true-hermaphrodites and plants propagated from them by cuttings, the Department has produced ninety tested hermaphrodites, fifty-nine tested females, and five tested males from crosses in which H1 and H2 have figured. In addition, there are 1,029 seedlings of hermaphroditic parentage in the breeding blocks of the experiment vineyard still untested. It is expected that not less than 50 per cent of these highest productiveness due to profuseness of bloom, vigor of growth, resistance to diseases and insects, etc., and then using these as parents of succeeding generations. To make this increase effective merely requires the introduction and substitution of the better new varieties for the present standard commercial sorts.

Second, increased productiveness has been gained by producing the new self-fertile hermaphroditic type of Muscadine grape having large clusters, self-fertility, and fruitfulness, to take the place of female varieties and of nonfruiting male vines serving as pollenizers for female varieties. Owing to the self-fertility of the hermaphrodites they

[5]This manuscript was prepared in November, 1916.

STANDARD AND IMPROVED GRAPE CLUSTERS

The small bloom cluster in the lower left-hand corner is typical of Scuppernong, the most widely grown variety of Muscadine grape. It bears only a few berries. The large cluster is typical of one of the improved hermaphrodites which the U. S. Department of Agriculture has produced as the result of many years of careful plant-breeding. It excels not only in size, but in almost every other characteristic. Photograph about one and one-half times natural size. (Fig. 15.)

have been found by test to set in bags over 33% of the bloom buds as berries, while Scuppernong, the most extensively planted commercial variety, sets naturally less than 10% of its buds as berries.

Third, by breeding for increased size of bloom cluster it has been possible not only to secure larger fruit clusters (a breeding object), but also increased productiveness. Large bloom clusters result in more perfect cross pollination and the size of bloom cluster is not necessarily in inverse ratio to profuseness of bloom cluster. The number of bloom clusters produced by a vine is ordinarily determined by its general vegetative condition, and little influenced by the size of the individual bloom cluster. Varieties with large bloom clusters secure better cross pollination and therefore are more fruitful. As the pollen-bearing insect is attracted to the flower by its odor,[6] a large bloom cluster has greater attracting power than a small one, and when the cluster is once found, all open blossoms are pollinated, whereas if this number of open blossoms is found on two clusters the insect might fail to visit one of them. Again, the large bloom cluster, in addition to having more buds open at a time, blooms over a period of two to three days and is therefore much more likely to have sufficient buds to produce a normal cluster open under favorable weather conditions. One illustration of the way these facts have been used in the Department's work seems warranted.

Among the fruiting varieties of Muscadine grapes Scuppernong is the oldest and the leading commercial sort. Its commercial value lies in its good light-colored fruit, and Scuppernong grapes have sold repeatedly to winemakers at good prices when dark-fruited varieties were not in demand. Still it can be emphatically stated that Scuppernong is one of the most unproductive varieties grown. An eight-year record (1904–1911) in a well-kept eastern North Carolina vineyard consisting of approximately 5 acres each of James and Scuppernong revealed that James yielded each year approximately twice as much fruit per acre as Scuppernong. Similar results have been repeatedly noted since. A prime reason for the relative lack of productiveness in Scuppernong has been shown by our pollination experiments to be its very small bloom cluster, which reduces the chances for cross-pollination by insects. The following data collected in connection with pollination studies will emphasize the bearing of size of bloom cluster on productiveness of Scuppernong and other commercial varieties. These data represent the averages of a very large number of individual observations during four seasons.

Variety	Average number of buds per bloom cluster	Average number of berries per ripe fruit cluster	Percentage of buds setting as berries under natural conditions
Scuppernong	23.8	2.5	4.64
James......	28.0	4.7	13.36
Thomas....	30.3	5.4	16.32
Flowers.....	40.3	5.1	15.10

The correlation shown in this table between size of flower cluster and natural productiveness is most striking. Working on the hypotheses suggested by such data as these, the Department has produced by intercrossing and selection many large-clustered seedlings of the Scuppernong type. A number of these having bloom clusters of 35 to 50 buds, with apparently correlated productiveness, are now being further tested with a view to determining which combine the greatest productiveness with high fruit quality. Thus we have succeeded in improving the productiveness of this most important commercial type while maintaining its distinctive characters.

[6] Experiments show that it is the odor of pollen in rudimentary stamens of the female blossom that attracts the insects.

A PRODUCTIVE NEW VARIETY OF MUSCADINE GRAPE

Fruiting arm of one of the varieties of Scuppernong type produced by the U. S. Department of Agriculture. It gives an idea of the Department's method of pruning Muscadine grapes to spurred arms. It was formerly said that the vines would "bleed to death" if pruned, and failure to prune was responsible for many low yields, until the Department demonstrated that Muscadine grapes need pruning just as all other grapes do. (Fig. 16.)

4. *Increase in Size of Fruit Cluster*

The success of our efforts to increase the size of fruit cluster by intercrossing emphasizes how easy it sometimes is, in plant-breeding, to get combined improvement along several lines, provided these are not antagonistic. The efforts just described to increase productiveness by increasing the size of flower cluster necessarily resulted also in increasing the size of fruit cluster. Again, the transformation of the large male-type bloom into a perfect hermaphrodite bloom has resulted in increasing the size of fruit cluster. A third way in which intercrossing has resulted in increased size of fruit cluster is through the pollination of small-clustered varieties with pollen from the largest-clustered male seedling in groups of seedlings descended from the largest-clustered fruiting varieties.

While a considerable increase in size of fruit cluster has been obtained by intercrossing and selection among resulting seedlings, the greatest progress along this line is to be expected from hybridizing with the large-clustered species of *Euvitis*.

5. *Better Berry Adherence*

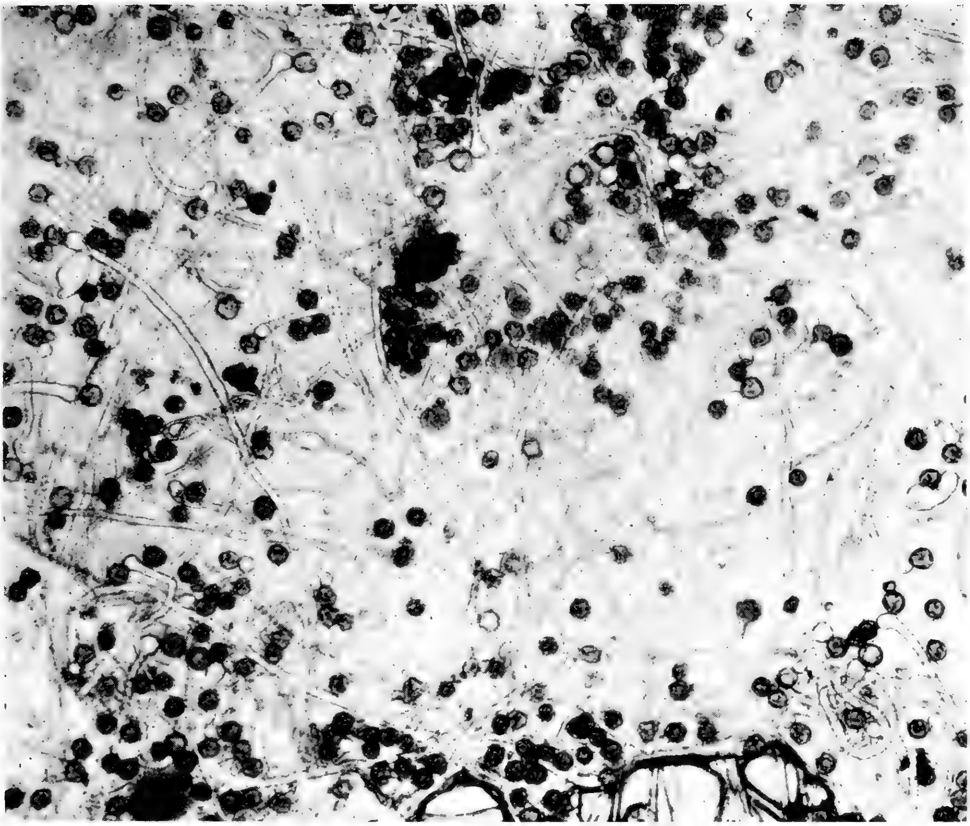
From a commercial standpoint, our improvement of the adherence of berry to pedicel by intercrossing is of great importance, since it makes possible the shipping of desirable varieties to distant markets. The standard Muscadine table varieties can not be successfully shipped, because the berries tend to shatter from the pedicels and in doing so the skin frequently breaks at the point of attachment, allowing juice to exude. This juice coats the berries, making them unattractive, sticky, and fermenty. Certain other varieties too coarse for table use and therefore undesirable for shipping, notably Flowers, have excellent berry adherence owing to full development of the fibrovascular bundles connecting the berry with the pedicel. By using male seedlings of Flowers and similar varieties in crosses with Scuppernong, Thomas, and other high-quality varieties of poor adherence, some desirable new types have been secured which combine quality and adherence.

6. *Increased Sugar and Decreased Acid Content*

The principal means used of reducing acid content has been to use parents and select offspring having a minimum of pulp juice and a maximum of so-called free-run juice, *i. e.*, the juice between skin and pulp of berry, as most of the acid content of the total juice of Muscadine and other native grapes occurs within the pulp. Sugar content is being increased by using such parents as Latham, Thomas, and Mish. A seedling of Latham parentage represents the greatest advancement in sugar content so far secured, but unfortunately has very small clusters. It is confidently believed that one or two more seedling generations will yield marked results in the effort to increase sweetness and reduce acidity. In this direction, however, greatest results are to be expected from hybridization with *V. vinifera*, the European grape.

7. *Improved Pulp Quality*

A number of seedlings of different parentages have been selected as having improved pulp qualities (smoothness, softness, and free liberation of seed.) In one lot of seedlings, however, the improvement has been especially marked. Among the first seedlings produced, one female seedling was selected as being exceptionally good because it combined with light-colored fruit and excellent berry adherence a remarkably melting pulp. In fact, there was no true pulp, the berries being merely globules of fruit juice. The juice, however, seemed a little too high in acid, and efforts have since been made to increase the sugar of this type while maintaining the desirable pulp and other qualities. A male seedling of the same cross as this exceptional one just described has invariably been found to impart the melting pulp character to its offspring. As a result we now have a considerable collection of melting-pulp seedlings of diverse parentage. These fruited for the first time in 1916 and will therefore require



VIGOROUS, GERMINATED POLLEN OF THE WINCHELL GRAPE

Each of the large dots in the above photomicrograph is a pollen grain. Most of them have germinated in a sugar-gelatin solution, and sent out long pollen tubes. Normally, this pollen tube grows into the ovary, after the pollen has fallen on a fruit-bearing flower, and down the tube the nucleus of the pollen-grain slips to unite with the nucleus of the ovule, thus setting in motion the machinery that will lead to the production of a grape-seed. The photograph, made at Willard, N. C., shows the condition of pollen as it was received by mail from Vineland, N. J. One of the chief factors in successful hybridization of the Muscadine grape has been the use of vigorous pollen. (Fig. 17.)

more testing before their full value can be determined. They are very promising.

8. *Decreased Size of Seed.*

Little reduction has been secured in the size of seed, but this character is considered of less importance than others, especially since the sizes of seed and berry are generally correlated.

9. *Thinner Skin of Berries*

Some reduction of the thickness of berry skin has been gained by intercrossing, especially with the variety Eden. A group of seedlings descended from Eden and James parentage is deserving of special mention here because of the uniform combination of good flavor and quality with thin skin, large berry and cluster, and good adherence. In this lot of seedlings some very promising light- and dark-fruited commercial types are to be found.

10. *Uniform Ripening*

Uniformity of fruit ripening seems to be dependent as much, on the weather at blooming time as on inherent varietal character. However, by working away from the everbearing trait of *V. munsoniana* and breeding

for large clusters, a little progress is to be expected. Most varieties ripen with sufficient uniformity if the weather is normal at blooming time.

RESULTS FROM HYBRIDIZING

So far the results from hybridization work are mainly in technique. The Muscadine grapes are so distinct and uncongenial to the other species of the grape family that hybridization is exceedingly difficult—so difficult, in fact, that the production of hybrids between *V. rotundifolia* and *Euvitis* species is considered an important result worthy of reporting, even though the hybrids have not yet fruited.

The difficulties to be encountered can be inferred from the experience of those who have given the matter most attention. J. Van Buren, of Clarksville, Ga., working prior to 1868, failed completely in the attempt. Dr. Peter Wylie, of Chester, S. C., working about the same time as Van Buren, produced several supposed Scuppernong hybrids which were lost to horticulture owing to a series of misfortunes, including the killing frost of April, 1872. T. V. Munson, of Denison, Tex., produced a few varieties which though predominantly Muscadine in character are supposed to be hybrids with *V. linceeumii*. Only four or five years ago a prominent State horticulturist made the statement that it was impossible to secure *V. rotundifolia* x *V. vinifera* hybrids. After two years' effort to produce hybrids of the *Muscadinia* and *Euvitis* species the North Carolina experiment station reported, in Technical Bulletin No. 10, complete failure with the exception of one weak plant, which was described when three years old as "still alive." A number of amateurs to whom we have sent pollen have all reported failure. The efforts of the U. S. Department of Agriculture were attended by failure until methods had been perfected and information regarding congeniality obtained. Since then, in addition to producing hybrids with various native grape species, the Department has produced the first known hybrids between *V. rotundifolia* and the European grapes, *V. vinifera*.

The Department's first efforts in this field, in 1911, resulted in complete failure. The next year one supposed hybrid was secured, a cross of Eden ♀ and Flame Tokay ♂, which has now fruited two years. While it is distinct from other Muscadine seedlings of Eden parentage, it is predominantly Muscadine in character and shows no resemblance to Flame Tokay except in the leaves. From the 1913 breeding work, twenty-two hybrids were secured, but only eight of these were living at the end of the first season in the vineyard. The others had succumbed to disease and inherent weakness. Of these eight seedlings, seven are of Olivette de Vendemain parentage and the result of one crossing operation. The other is the result of pollinating Scuppernong with Winchell. These seedlings have not yet fruited, but they should do so in the season of 1917. The Scuppernong ♀ x Winchell ♂ seedling is the only hybrid we have secured of Scuppernong parentage. It resembles Winchell more than Scuppernong, though from a Scuppernong seed. It is undoubtedly a true hybrid. The Olivette de Vendemain hybrids are variable in vigor and characters, some being vigorous and others weak; some are more Vinifera in type and others more Muscadine, but all are undoubtedly true hybrids. From the 1914 breeding work a considerable number of seeds was secured, but many of these failed to germinate. However, the following true hybrids were propagated and are now growing at Willard, N. C.:

2 seedlings of Eden x Maraville de Malaga
1 seedling, Thomas x Rodites
3 seedlings, Thomas x Carignane
1 seedling, Thomas x Noah
1 seedling, V16 R6 B2 x Carignane
3 seedlings, V17 R6 B2 x Terret Monstre

In 1915 much greater hybridization success was had. A large collection of seeds was secured and though many of these failed to germinate, seventy true hybrids have been propagated. The following *Euvitis* varieties are represented in the parentage of these hybrids:

AUTHENTIC HYBRID BETWEEN EUROPEAN AND MUSCADINE GRAPE

It is so difficult to hybridize Muscadine grapes with European grapes that doubt has often been cast on the genuineness of some of the alleged hybrids. This photograph shows that there can be no doubt about the hybrid nature of those secured by the U. S. Department of Agriculture. The hybrid shows its *rotundifolia* parentage by simple tendrils, leaf texture, and stem, and its *vinifera* parentage by forked tendrils, leaf lobes and variable size of leaf-serrations. Other characters are more or less intermediate. (Fig. 18.)

Muscat of Alexandria	Huasco
Calabrian	Winchell
Ferrara	Goethe
Rodites	Brilliant
Semillon	Catawba
White Hanepoot	Iona
Prune de Cazouls	Ives

In 1916 a still larger crop of hybrid seeds was secured from breeding work, and is now being grown.

The Department's success in producing Muscadine-Euvitis hybirds is attributable to the perfecting of methods, the use of varieties of greatest congeniality, and the selection of healthy, vigorous vines as parents. Of the commercial varieties of Muscadines, Thomas seems most congenial to *Euvitis* pollen. A number of the Department's seedling varieties, however, are even more readily hybridized. Certain *Euvitis* pollens can be more successfully used than others. These lines of congeniality have been established by experience. In hybridizing, only Muscadines have been used as the female parent; because of their dioeciousness, and because *Euvitis* pollen can be shipped more successfully than Muscadine pollen. *V. vinifera* pollen has been collected in the Department's experiment vineyards at Oakville and Fresno, Cal., by associates and mailed to Willard, N. C., where it was used in hybridization work after testing to prove its viability. Other *Euvitis* pollens have been collected at the Department's experiment vineyard at Vineland, N. J., and mailed to Willard for use.

While the hybrids have not yet fruited, it is an important result of breeding work to be able to say that *Muscadinia* x *Euvitis* hybrids are being secured in quantity. The hybridity is conclusively proved by their possession

of botanical characters of both *Muscadinia* and *Euvitis* as, for example, in the case of the tendrils. The *Muscadinia* species always have simple tendrils and the *Euvitis* always forked tendrils, while the hybrids generally have simple and forked tendrils on the same shoot. In like manner, the hybirds have both continuous and discontinuous pith, etc. It is expected that the first hybrids will leave much to be desired, but in a large collection a few valuable individuals may be found which, when again crossed with the best Muscadine or *Euvitis* varieties, will yield satisfactory results.

While improvement is expected from the Muscadine hybrids with native grape species, the greatest results are expected from the hybrids with the European grape, *V. vinifera*, because the latter varieties are strong in those characters in which the Muscadines are deficient, and weak only in the characters well developed in the Muscadines. For example, *V. vinifera* is very high in sugar but low in acid content, while the Muscadines are high in acid content but low in sugar. The native American *Euvitis* species, while having a higher sugar content generally than the Muscadines, are like the latter in their high acid content.

SUMMARY

The Muscadine grape breeding of the U. S. Department of Agriculture[7] is centered in a coöperative experiment vineyard located on the North Carolina State Department of Agriculture's Test Farm, Willard, N. C. Here pollination, culture, handling, marketing, and utilization problems have also been under investigation. Special emphasis has been given to pruning, training, and pollination studies, but the breeding investigations have occupied first place.

It is believed that with the achievement of the results from breeding work for which the Department is striving, together with the development of improved methods of growing, handling, and utilizing the fruit, the Muscadine grape industry will take a leading position among the fruit industries of the South and will afford a profitable means of utilizing a portion of the vast areas of cut-over pine lands of the Southeast.

Peculiarities of Conformation in Singers

As the conformation of those parts of the head used for singing is inherited, it is natural to suppose that singing ability is largely dependent on heredity. Dr. Irving Wilson Voorhees, who writes in the July issue of *Medical Review of Reviews*, gives some details about the peculiarities of conformation which show why training alone cannot produce a singer.

"I have studied the noses and throats of several of the great singers," he says, "and in each and every case can say that there was something remarkable about the formation of the nasal chambers or vocal cords or general muscular development of the chest. It is not always possible to tell what a voice is by a physical examination, but many times one can make a fair guess at it. The tenor's vocal cords, for instance, are likely to be short and thick; the basso's, long and flat. Like differences hold good for female voices. I am told by a physician who has examined Caruso that he has a broad roof to the mouth, a large nasopharynx, very roomy nasal resonators, and short, thick vocal cords with knife-like edge."

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[7] The progress of the Department's work with the Muscadine grapes has been reported in the reports of the Chief of the Bureau of Plant Industry and in the following bulletins:
Bulletin 273, Bureau of Plant Industry, The Muscadine Grapes.
Farmers' Bulletin 709, U. S. Department of Agriculture, The Muscadine Grapes.
Farmers' Bulletin 758, U. S. Department of Agriculture, Muscadine Grape Sirup.
Farmers' Bulletin 859, U. S. Department of Agriculture, Home Uses for Muscadine Grapes.

SELECT ARMY AVIATORS BY TEST, NOT BY EDUCATION

Roswell H. Johnson, *University of Pittsburgh*

THE work of an aviator is notoriously hazardous. In spite of this fact, the Government, instead of contenting itself with a minimum requirement for aviation, has in accordance with the following quotations directed that a college education shall be requisite.

The office of the Chief Signal Officer, War Department, authorizes the following:

The following instructions relative to the determining of educational qualifications of applicants for commission in the aviation section of the Signal Officers' Reserve Corps are announced:

Paragraph 10, Special Regulations No. 50, Aviation Section, Signal Corps, 1917, prescribes in line 7, "The mental examination may be omitted, but the equivalent of a college education will be required."

Line 14, paragraph 13, of the same order prescribes, "The applicant will be required to establish the fact that he has the equivalent of a college education."

The Chief Signal Officer of the Army directs me to inform you that the following will govern in determining whether or not an applicant possesses the required educational qualifications:

(*a*) The applicant must have completed a course at a recognized college or technical school or have the equivalent of such an education. In determining this equivaent consideration will be given to the applicant's intelligence, business or other training, travel, tutoring, home study, activity, and military training. In all cases the applicant must have completed a course at a high school or preparatory school of good standing. In each case the examining board must use discretion and judgment as to whether the applicant possesses the requisite training and judgment to enable him to perform the duties of a commissioned officer in the aviation section.

Roughly, of course, a college education indicates that an individual must belong to a certain mental grade of intelligence to have survived the process, but the qualifications necessary for an aviator are not those necessary to have survived a college education. To consider these qualifications, what can we do better than to examine the men who have been successful motorcycle and automobile racers? We suggest to the Government that psychological tests upon men who have been successful along these lines will give them what they want, coupled with the tests on the sense of equilibrium and control which are being employed. To use a college education fails to make the discrimination the Army desires, and it brings into this dangerous profession a number of men who are not needed, or who are needed in other work to a greater degree. It seems axiomatic that the nation should strive to pass through a war with the minimum loss in quality and quantity of its members. This, then, demands a far more careful selection of candidates.

We believe that the same reasoning applies in the matter of officers in the Infantry and Cavalry. The qualities here called for are better represented in men who have proved successful as foremen, than in those who are college graduates, many of whom will be ludicrous failures in the handling of men, and yet have other qualities far too valuable to waste in service to which they are not well adapted. If mental tests are to be used in the selection of officers, these tests should not be those of general intelligence but rather specially made out for those peculiar qualifications which are desirable in an army officer—in other words, what the psychologist calls a differential mental test, rather than a general one.

COLOR INHERITANCE IN MAMMALS

III. The Rat—Few Variations of Factors Known until Recently—Castle's Selection Experiment—Any Interpretation of It Demonstrates the Efficacy of Darwinian Selection

SEWALL WRIGHT

Bureau of Animal Industry, Washington, D. C.

UNTIL recently rats were relatively poor in known color varieties. Blacks, albinos and hooded blacks and grays were the only varieties known besides the wild gray color. Three recessive Mendelian factors, called here S_h, C_a and a, were demonstrated early by the work of Bateson,[1] Doncaster,[2] MacCurdy and Castle,[3] and others. These obviously are variations of a similar nature to piebald, albinism and black (or rather loss of agouti pattern) in mice and are to be assigned to classes $1a_2$, 1b and $2a_1$, respectively.

In 1914, Castle[4] reported on two new variations which had appeared independently as sports among wild rats in England. They are of rather similar apperance, the gray color of the wild rat in both cases being changed to a yellow, in which, however, the base of the hair is a pale slaty color. When the agouti factor is replaced by a, the entire fur is of this pale slaty color. The only distinct difference between the two variations is that in one the eyes are reduced to pink, in the other merely to a dark red. Both of them behave as simple recessives. In spite of their great similarity in effect Castle found them to be independent variations, reproducing a gray only a little less intense than the wild gray when crossed together. In fact, it was found difficult to get them into the same gamete and Castle and Wright[5] reported on a very high degree of linkage between them. Castle[6] further found indications that both of them are linked with albinism. This would be of very great interest if confirmed by further work in view of the probable linkage between albinism and the pink-eyed factor p of mice in the data of Darbishire and Cuénot. The pink-eye factor of mice is the nearest homologue of the pink-eye factor of rats. Both reduce black to a pale slaty brown in the fur, and nearly eliminate it in the eye but do not affect yellow. In agoutis there seems also to be some widening of the agouti band, due to the weakening of the black.

Gray Rat—S C A	*R P*	*(Pattern of black and yellow)*
$1a_1$	—	
$1a_2$	S, S_m, S_h	S_m white-bellied gray, S_h hooded gray.
$1a_3$	—	
1b	C, C_r C_a	C_r red-eyed dilute gray (sepia and white), C_a albino.
$2a_1$	A, a	a black.
$2a_2$	—	
$2a_3$	—	
2b	R, r	r red-eyed yellowish gray (very dilute black and intense yellow).
	P, p	p pink-eyed yellowish gray (very dilute black and intense yellow).

Thus the appearance of the red-eyed and pink-eyed agoutis is practically yellow. Both factors, however, must be placed in class 2b as being more similar in their action to the brown and pink-eyed colored variations of other

[1] Bateson, W. 1903. *Proc. Zool. Soc.*, 2:71–78.
[2] Doncaster, L. 1905. *Proc. Camb. Phil. Soc.*, 13:215–227.
[3] MacCurdy, H., and Castle, W. E. 1907. *Carn. Inst. Wash. Pub. No.* 70, 50 pp.
[4] Castle, W. E. 1914. *Amer. Nat.*, 48:65–73.
[5] Castle, W. E., and S. Wright, 1915. *Sci. N. S.*, 42:193–195.
[6] Castle, W. E. 1916. *Carn. Inst. Wash. Pub. No.* 241, part iii:161–187.

rodents than to recessive yellows such as found in guinea-pigs or rabbits.

A very different kind of dilution of coat and eye color in rats was discovered by Whiting.[7] In his red-eyed dilute rats, the yellow of the agouti band is reduced entirely to white, while the black is relatively little affected. He pointed out its very similar character to the red-eyed dilution of guinea-pigs and tests, which he made, soon showed that it is also genetically similar in being an allelomorph of albinism. As in guinea-pigs, he found it to be imperfectly dominant over albinism, but recessive to the intense color of wild grays. It is, of course, to be placed in class 1b.

THE HOODED PATTERN

Probably the most interesting experiments with rats are those dealing with the hooded pattern. This pattern is much less apt to be asymmetrical than the piebalds in most other mammals. Its variations can be arranged practically in a single linear series. White first appears in small patches on the feet and belly, creeps up the sides until the typical hooded pattern is reached—a black head and narrow mid-dorsal stripe, then obliterates the latter and gradually reduces the black on the head. Doncaster recognized four kinds of rats with regard to pattern—self, Irish a, Irish b, and hooded. The Irish rats are nearly self with white on the belly. He found that hooding was a clear-cut recessive to the others but that the Irish rats were of two sorts genetically. Some of them (class a) bred essentially like self rats, never producing piebalds. In these the ventral white appeared to be a fluctuating variation independent of the hooding. Other Irish rats (class b), usually with more ventral white than class a, produced 50% hooded rats in crosses with the latter and were evidently heterozygotes between self or Irish a and hooding. Castle[8] obtained similar results and carried on a very extensive experiment on the effects of selection on the hooding pattern, the results of which have called forth a great deal of discussion. By long continued selection the means of a plus and minus series have been carried far beyond the extremes of variation in the original stock, approaching the condition of Irish rats on the one hand, and black-eyed white on the other. In the course of the experiment a big advance appeared suddenly in two rats of the plus series, and at once behaved as a unit Mendelian dominant to the stock from which it rose. Rats from this source were called the mutant stock. Otherwise progress was very slow and uniform.

The results obviously have a most important bearing on the efficacy of selection in evolution, or in live-stock breeding operations. Most discussion, however, has centered on the interpretation of the means by which selection has worked. There are really two problems here. It has been widely held that new variations are so rare that they can virtually be neglected in interpreting such an experiment.[9] On this view, selection has worked merely by sorting out favorable combinations of factors already present in the original stock. Professor Castle, on the other hand, has held that the results could only be explained satisfactorily on the view that minute variations occur frequently if not almost invariably in the production of germ cells. His idea of the powers of selection is thus in essential agreement with Darwin's. A second problem is on the nature of the genetic basis of the different grades of the hooded pattern. On any view, a large part of this variation is not genetic but merely developmental. This is shown by the low correlations between parent and offspring. The weighted average is +.23 in plus series and +.18 in minus series for sixteen and seventeen

[7] Whiting, P. W. 1916. *Sci. N. S.*, 43: 781.

[8] Castle, W. E. 1912. *Amer. Breed. Mag.*, 3: 270–282. 1915. *Amer. Nat.*, 49: 37, 49: 713–726. 1916. *Loc. cit.* 1917. *Amer. Nat.*, 51: 102–114. Castle, W. E., and J. C. Phillips. 1914. *Pub. Carn. Inst. Wash.* No. 195, 56 pp.

[9] See for example, Muller, H. J. 1914. *Amer. Nat.*, 48: 567. MacDowell, E. C., 1916. *Amer. Nat.*, 50: 719–742.

generations respectively. The variations with a genetic basis may be due either to variations of the main hooding factor S_h in which case the different grades should be allelomorphs of each other (except for the non-genetic variation) or to the coöperation of independent factors with the hooding factor. Those who hold to an exceedingly stable germ-plasm must adopt the second view, at least in the main, to account for the success of selection. If, however, selection has worked through the appearance of numerous small variations these might be of either kind. Professor Castle has pointed out both possibilities and, indeed, has proved that both kinds of variations exist in particular cases. He attributes, however, more weight to variations of the main factor than to independent ones. The writer is inclined to reverse the emphasis.

ANALYSIS OF THE DATA

A rough analysis of the data on the assumption that both kinds of variations exist yields some very interesting results. Let it be assumed that the factor S is varying and that each generation or stock has its characteristic mean allelomorph in the series, which may be represented by S_{10+}, S_{10-}, S_W, S_M, S_I, etc., for the tenth plus and tenth minus generations and the wild, mutant and Irish stocks, respectively. Assume also that there is a large array of independent factors with respect to which each generation and stock has a certain average condition which may be represented by Σ_{10+}, Σ_{10-}, Σ_W, Σ_M, Σ_I, etc. Assuming variation to occur at random in both directions, a given factor as S_{10+} should come out of any cross at the same average level, S_{10+}, that it went in. Justification of this assumption may be found in the crosses of the tenth plus generation with the mutant rats spoken of above which came from this generation. The tenth plus generation were of an average grade of +3.73 on Professor Castle's scale in which +6 is self and −4 a nearly solid white with only a little black on the head. The mutants were about grade +5.50 but in F_2 or later generations of the cross of tenth plus with mutant the hooded segregates averaged very close to +3.73 (actually +3.79) showing that in a cross in which the same independent factors should be present in both parents, the hooding factor segregates out unchanged after a generation in nearly self rats. In regard to the independent factors, the best working assumption for the average produced by any cross or back cross seems to be blending inheritance. Thus F_1 from tenth plus (grade +3.73) by tenth minus (grade −2.01) was +1.00 in grade, about half way between the parents, and F_2 averaged nearly the same, +0.73, although with somewhat greater variability showing slight indications of segregation. The standard deviations were +0.60 and +0.87 in F_1 and F_2 respectively. This cross would be presented by the symbols above as follows:

$$S_{10+}S_{10+}\Sigma_{10+} \times S_{10-}S_{10-}\Sigma_{10-} = S_{10+}S_{10-}\ \frac{\Sigma_{10+}+\Sigma_{10-}}{2}$$

In F_2 there should be segregation of S_{10+} and S_{10-} but the *average* condition of the independent factors should still be $\frac{\Sigma_{10+}+\Sigma_{10-}}{2}$.

By this method it is possible to deduce roughly the average grade of rats which have derived their hooding factor from one source and the entire array of independent factors from another. Thus F_1 from the cross mutant by tenth minus must be $S_M S_{10-}\frac{\Sigma_M+\Sigma_{10-}}{2}$ and the easily recognized hooded rats in F_2 must on the average be of formula $S_{10-}S_{10-}\frac{\Sigma_M+\Sigma_{10-}}{2}$. But this is the same as F_1 between minus and a hypothetical stock with the main hooding factor of the tenth minus generation, but the residual heredity of the mutant stock, $S_{10-}S_{10-}\Sigma_M$. The F_2 segregates from the cross tenth minus with mutant, then, should be just half-way between the tenth minus and the hypothetical stock in grade, which enables us to deduce the grade of the latter. The following table is thus derived from crosses given by Castle

between various generations of hooded stock and the mutant, wild and Irish stocks respectively. In interpreting the results, the strength or weakness of the various assumptions made must, of course, be born in mind.

counts for more than variation of the main factor, although it is to be noted that hooding from plus rats in each case does average a little more than hooding from minus rats. The general difference in residual heredity between

From table[10]	Source of recessives	No. of rats	Mendelian formula of extracted recessives	Grade in selection experiment	Grade in extracted recessives	Deduced grade with residual heredity of mutant, wild or Irish stock
55	F_2 from mutant × minus ($F_1=S_MS_{10}-$)	14	$S_{10}-S_{10}-$	$\Sigma_{10}-$ -2.01	$\Sigma_{10}-+\Sigma_M$ $+0.75$	$\Sigma_M+3.51$
51	F_1 from mutant × plus	58	$S_{10}+S_{10}+$	$\Sigma_{10}+$ $+3.73$	$\Sigma_{10}++\Sigma_M$ $+3.73$	$\Sigma_M+3.73$
53	F_1 and F_2 mutant × mutant	8	$S_{10}+S_{10}+$	$\Sigma_{10}+$ $+3.73$	$\Sigma_{10}++\Sigma_M$ $+3.75$	$\Sigma_M+3.77$
51, 53, 54	Total mutant × plus crosses	136	$S_{10}+S_{10}+$	$\Sigma_{10}+$ $+3.73$	$\Sigma_{10}++\Sigma_M$ $+3.76$	$\Sigma_M+3.79$
42	F_2 from wild × minus	91	$S_{10}-S_{10}-$	$\Sigma_{10}-$ -2.01	$\Sigma_{10}-+\Sigma_W$ $+0.24$	$\Sigma_W+2.48$
42	F_2 from wild × minus	48	S_6-S_6-	Σ_6- -1.56	$\Sigma_6-+\Sigma_W$ $+0.25$	$\Sigma_W+2.06$
42	F_2 from wild × minus	62	$S_{2½}-S_{2½}-$	$\Sigma_{2½}-$ -1.13	$\Sigma_{2½}-+\Sigma_W$ $+0.31$	$\Sigma_W+1.74$
42	F_2 from wild × plus	21	S_3+S_3+	Σ_3+ $+2.51$	$\Sigma_3++\Sigma_W$ $+2.56$	$\Sigma_W+2.61$
42	F_2 from wild × plus	38	$S_{5½}+S_{5½}+$	$\Sigma_{5½}+$ $+3.00$	$\Sigma_{5½}++\Sigma_W$ $+2.97$	$\Sigma_W+2.94$
42	F_2 from wild × plus	16	$S_{10}+S_{10}+$	$\Sigma_{10}+$ $+3.73$	$\Sigma_{10}++\Sigma_W$ $+3.15$	$\Sigma_W+2.57$
141[11]	F_2 from wild × plus	73	$S_{11}+S_{11}+$	$\Sigma_{11}+$ $+3.78$	$\Sigma_{11}++\Sigma_W$ $+3.17$	$\Sigma_W+2.56$
141[11]	F_2 from F_2 (wild × plus) × plus	256	$S_{11}+S_{11}+$	$\Sigma_{11}+$ $+3.78$	$\Sigma_{11}+$ $+3\Sigma_W$ $+3.34$	$\Sigma_W+3.19$
43	F_2 from Irish × minus	66	$S_{7½}-S_{7½}-$	$\Sigma_{7½}-$ -1.77	$\Sigma_{7½}-+\Sigma_I$ -0.94	$\Sigma_I-0.11$
43	F_2 from Irish × minus	53	S_4-S_4-	Σ_4- -1.28	$\Sigma_4-+\Sigma_I$ -0.73	$\Sigma_I-0.18$
43	F_2 from Irish × minus	90	$S_{3½}-S_{3½}-$	$\Sigma_{3½}-$ -1.23	$\Sigma_{3½}-+\Sigma_I$ -0.62	$\Sigma_I-0.01$
43	F_2 from Irish × plus	239	S_2+S_2+	Σ_2+ $+1.92$	$\Sigma_2++\Sigma_I$ $+1.27$	$\Sigma_I+0.62$
43	F_2 from Irish × plus	23	S_3+S_3+	Σ_3+ $+2.51$	$\Sigma_3++\Sigma_I$ $+0.95$	$\Sigma_I-0.61$

From the table it appears that with a given residual heredity the main hooding factors derived from the plus and minus series produce but little difference in effect. Thus, finding the weighted average for hooded rats derived from the plus and the minus strains when associated with the residual heredity of the mutant, wild and Irish stocks, respectively, we get the following results:

Source of hooding factor	*Residual heredity* *Mutant*	*Wild*	*Irish*
Plus	+3.79	+2.99	+0.51
Minus	+3.51	+2.15	−0.08
Difference	+0.28	+0.84	+0.59

It appears that residual heredity the Irish and wild rats seems very clear. This suggests that Irish rats may possess the same hooding factor as wild rats, but owe their white bellies to minus selection or, more likely, to crossing with hooded rats which had been selected in a minus direction.

In the case of the mutant rats, however, there would seem to be no room for doubt that we are dealing with a real variation of the hooding factor intermediate between the level in wild or Irish rats and that in hooded rats. The mutants look like Irish rats in having white on the belly but breed very differently. They possess the residual heredity of the plus selection series

[10] Castle, W. E., and Phillips, J. C. 1914. *Loc. cit.*
[11] Castle, W. E. 1916. *Loc. cit.*

from which they sprang, which is at a distinctly higher level than that of the wild stock and at a very much higher level than that of the Irish. With the residual heredity of the minus selection series they would doubtless look like ordinary hooded rats. There remains one possible different interpretation. Mutants may differ from their hooded ancestors by a factor which is wholly independent of that present in wild rats. Symbolically, hooded rats may be S_hS_hmm, mutants S_hS_hMM, while wild rats are SSmm. Castle has, however, virtually eliminated this possibility by crossing wild with mutant and raising an F_2. On the hypothesis of independence 6% hooded rats should appear in F_2 but among forty-six individuals none such appeared.

Thus genetic variations of the hooding factor and ones independent of it are both present to give a basis for selection. The origin of the mutants in the course of the experiment, of course, demonstrates that there is no absolute stability of the germ plasm. Further, where there is one variation which is of great enough effect to be recognizable at once, many more smaller should perhaps be expected. Whether the selection actually has progressed largely through favorable combinations of factors or through the occurrence of small mutations is not easy to answer. MacDowell has cited the decrease in the standard deviation as evidence that each selection series is becoming more nearly homozygous. It is, however, not certain that a grade near the extremes of the series means exactly the same thing as near the middle. The fact that the correlation between parent and offspring shows actually a slight increase as selection progresses indicates that the ratio of genetic to somatic variation has not suffered and argues for the frequent occurrence of new variations. These may, of course, be largely independent of the hooding factor in inheritance. It should be added that the large amount of somatic variation and the absence of close inbreeding make it highly improbable that the parent-offspring correlation can be due to a splitting up of each selection series into non-interbreeding groups, even though there is assortative mating.

Summing up, it appears most probable to the writer that genetic variations are occurring sufficiently often to give a basis for selection to an indefinite extent. Most of such variations seem to be inherited independently of the hooding factor, but at least in one case it has been demonstrated exhaustively that the hooding factor itself has varied to a new level in the direction of its allelomorph in wild rats.

Conditions are doubtless more or less similar in other piebald animals. In most cases, however, the variability due to irregularity in development is greater than in the rat. This is notably the case in the guinea-pig in which the pattern remains exceedingly variable after generations of the closest inbreeding. Yet in a stock breeding at random the correlation between parent and offspring is about the same as in rats. Perhaps the irregularity in development argues a genetic instability from which even the germ cells are not exempt.

Finally, under any interpretation, Castle's selection experiment demonstrates the efficacy of Darwinian selection. It is true that one large mutation occurred with effects perhaps as large by itself as the entire plus selection series, but where such a variation gives one new level, selection has produced a continuous series of stable levels. This would give selection of small variations a more important place in evolution and animal husbandry where it is nice adjustments of one character to another or to the environment that count.

PITCHER-LEAVED ASH TREES

The above photograph shows a leaf of an ash tree (*Fraxinus americana*), grown from seeds of a similar tree found in 1904 near the Station for Experimental Evolution, Cold Spring Harbor, Long Island. It will be noted that several of the leaflets form little conical cups. Such leaves are known as ascidia or, popularly, "pitchers."

As stated in *Science*, May 18, 1917, trees of this type were supposed to grow only at Cold Spring Harbor, until their discovery last summer at two points in eastern Pennsylvania. In order to determine the probable evolutionary history of these trees it is necessary to know their present geographical distribution. Are they the result of recent mutations, or the remnants of an older, more widely distributed form?

The peculiar form of the leaflets is so readily observed, particularly on young trees, that I hope the readers of this journal will make note of their observations and communicate the results to me. Anyone who is willing to assist in this study should examine all the ash trees accessible to him, and let me know approximately the area covered by the observations, and the number of *normal* ash trees observed, as well as the number of pitcher-leafed trees, if any. It is just as important for the purpose of this study, to know that pitcher-leafed trees do *not* occur in a given locality as to know that they do. (Fig. 19.)

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THE DISAPPEARANCE OF THE MALE MONONCH

OF ALL the nematodes or thread-worms, few are more common than the Mononch. Its microscopic size conceals its abundance. Hundreds of millions of them may be found in a single acre of garden soil. Dirt is usually thought of as dead matter, but to a magnifying eye it would appear to be almost alive, a squirming mass of micro-organisms, abundant among which would be the Mononchs, benefiting the agriculturist by rapaciously destroying many other nematodes and micro-organisms that injure plants.

The remarkable sexual history of these nematodes is described by N. A. Cobb (Contributions to a Science of Nematology, VI, *Soil Science*, May, 1917). In most mononchs males are either nonexistent or else so rare as to be negligible, a single one occurring perhaps among several thousand females. In these circumstances, the male has ceased to play an important part in reproduction, and the female has developed the capacity to produce sperm and ova in the same organ—a condition that Dr. Cobb calls syngonism. Early in her life the female produces a quantity of spermatozoa, which are stored away by her. Later the female sexual characters develop and she produces ova, which are fertilized by her own, exceedingly minute spermatozoa. In some nematodes the spermatozoön seems merely to give a stimulus to the egg, which then develops parthenogenetically; but in those studied by Dr. Cobb it seems likely that there is a real fusion of the two sex-cells, which, therefore, probably differ in the same way that the male and female reproductive cells of other animals do. It is possible, Dr. Cobb suggests, that in other animals where the ovum is thought to develop without fertilization, it may, in reality, be fertilized by a very minute,

A MONONCH

Garden soil is full of microscopic thread-worms like this. The head of the specimen here figured is accurate in every detail; the body is somewhat posed. Its mouth is wide open, showing its prominent single fang. It feeds on other thread worms. From a drawing by W. F. Chambers. (Fig. 20.)

hitherto overlooked spermatozoön produced by the female herself, just as in the case of the Mononch.

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CONTENTS

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Photograph by John Howard Paine.

A WOMAN WITH HORNS

The above photograph (twice natural size, in order to bring out the detail) shows a horn removed from the forehead of a woman.

Growth started less than 18 months ago.

Many say they have heard of monstrosities like this but never seen them. An active general practice of 35 years has given me opportunity to see many things in this line, but never before have I seen one so well marked and so significant.

The woman from whom this was taken is 78 years old, born in America of German descent, in a family peculiar as to mentality, some members being up to or above normal, others decidedly defective.

This horn was not attached to the skull, but was merely a development of the skin. It was fed by a small spur from the temporal artery, the blood supply being so well developed that profuse hemorrhage followed the operation.

One of the most striking facts in connection with the case is that a similar horn was removed from the opposite side of the face a year ago. The sites of the two scars correspond very accurately; hence horns are bilaterally symmetrical, just as in most animals. (Frontispiece.)

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AMERICA'S FIGHTING STOCKS

Half a Dozen Races Available for War, Each Valuable in Its Way—Brunt of Battle Will Be Borne by Old Americans of Nordic Descent—Officers Nearly all Nordics

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IN EVERY American city, bright-colored posters appeal to the youth of the nation to enlist for the war.

Almost without exception, these posters present pictures of clean-cut, tall, fair, long-skulled youths, with every appearance of possessing the qualities of leadership and initiative. This is America's concept of the typical soldier.

If an anthropologist should paint a picture of a typical member of the Nordic race, he would portray just such a man as now appears on the recruiting posters.

This exact identity of the typical United States soldier and the typical Nordic is not a coincidence, nor the result of artistic inventiveness; it is due to the fact that the soldiers of this country have always been Nordic, and will be Nordic at least during the present war, in overwhelming preponderance. Many soldiers will, of course, be found who present the direct opposite of the Nordic characteristics, and for this reason will be more noticed individually than is the common type, but they will not be typical of America's fighting forces.

While the officers of an army built up in time of peace are not chosen primarily for fighting ability, a survey of the ancestral nationality of American army officers is nevertheless of interest. It can be made in a rough way by noting the apparent nationality of the family name. On this basis, 4,233 regular commissioned officers of the U. S. Army were taken from the 1916 *Register* and classified as follows:

Great Britain		89.8%
English	81.0	
Irish	3.5	
Scotch	4.3	
Welsh	.1	
Germany		7.7%
France		2.0
Holland		1.6
Scandinavia		1.5
Spanish		.5
Jewish		.1

Even if abundant allowance is made for the inaccuracy of this method, it is evident that more than nine-tenths of the regular army officers are Nordics, nearly all of them Anglo-Saxons. The Mediterraneans are represented by the Welsh and a scattering from other parts of Great Britain, no doubt. The Spanish names in the list belong to Porto Ricans or Filipinos. The French names probably represent Huguenot families (mostly Nordic); the Hollanders are doubtless representatives of the old Dutch families of New York.

The privates, while not so overwhelmingly Nordic, still have for the most part the tall stature and blondness characteristic of the Nordic race. According to calculations made by the Surgeon General's Office, the average infantryman is 67.4 inches in height, with chest girth (deflated) of 34.07 inches, weighs 147.07 pounds and is 30.9 years old.

THE NORDIC RACE

The Nordic race probably took its present form somewhere in eastern Russia, although it may have come from Africa at an earlier period in the world's pre-history. It is one of the three principal races of Europe, the other two being the Mediterranean and the Alpine. The former came into Europe from the south—*i. e.*, Africa—and is represented mainly by the Latin races; in appearance it differs from the Nordic mainly in being shorter and darker. The Alpine race is made up of a flood of round-headed,

long-bearded invaders who came from middle Asia, bringing copper implements and spreading over the Balkans and the near east until they pushed a wedge clear across Europe to the Atlantic.

THE AVERAGE SOLDIER

This painting was made for the Army Medical Museum some years ago, to illustrate the typical American infantryman. The height, weight and chest measurements were supplied from the statistics of the Surgeon-General's office. The model was a young Irish regular, whose head-form and dark hair and eyes are hardly typical of the American Army. (Fig. 1.)

The United States is perhaps more preponderantly Nordic in population which is liable to draft than any other country actively engaged in the great war, with the possible exception of Great Britain. It was in origin a Nordic colony, and more than 50% of its residents are today native whites of native parentage, almost 25% are native whites of foreign or mixed parentage, while but 14.5% are foreign born whites. The remaining 11.1% include 10.7% negroes, and .4% Indians, Chinese, Japanese, and all others.

Thus the native whites, who are distinctly and almost wholly Nordic, comprise a little more than one-half of the entire population, while in the other half, the Nordic stock certainly still holds the majority, as will be later shown, so that more than three-quarters of the total population is of Nordic descent. Furthermore, the Nordic stock consists almost entirely of citizens who will hence have to bear the brunt of the war, while many of the Alpine and Mediterranean immigrants have not become naturalized.

A DEFECT OF THE DRAFT

The allotment of draft quotas without exclusion of aliens was, from the eugenic point of view, a serious mistake in the draft. The result was that in many of the New England communities, where the proportion of aliens is large, an overwhelmingly large burden was thrown on the old American population. Captain Eben Putnam writes that in some communities it was impossible to fill the quota even when every native in the district was summoned. It would have been better to base the draft quotas on the population after aliens were excluded. While the old Nordics of the United States are willing to bear their full share of the burden of the war, and in fact will bear vastly more than their share without a protest, it seems more statesmanlike to distribute the burden as far as possible.

The Nordic always has shown the most marked pugnacity. The famous warriors of Sumer and Accad were evidently long-headed, tall and fair-haired. Achilles and Hector are supposed to have been Nordics. The Goths and Gauls that poured down over the Alps and literally wiped the Roman Empire off the map were of the same peace-disturbing race.

In Europe at the present time, a much larger proportion of the fighting men belong to the Nordic race than is generally supposed. Of course, the Scandinavian peninsula, where the Nordic is found in the greatest purity at the present day, has up to this time kept out of the conflict, but Nordics are to be found extensively in the fighting forces of most of the nations at war. Practically all the men from the northeast of Great Britain are pure Nordics, while the rest of the population is predominantly of Nordic blood, mixed with Mediterranean blood in the southwest. North of Paris France is largely Nordic, with the central region populated by Alpines, and the southern border by Mediterranean stock. In Belgium, the division is made between the Nordic Flemings and the Alpine Walloons.

The Central Allies depend no less on a strong fighting force of Nordic extraction. Germany is Nordic along the northern plains from whence come the Prussian militarists, and Alpine along the southern uplands. Austria is preponderantly Nordic, although Cevanolia and Anatolia are populated by a large percentage of brachycephs who are probably of Alpine origin. Hungary is peopled largely by pugnacious Magyars, who are nearly all dark, short and brachycephalic, and are mainly of Alpine blood.

In Russia, the Letto-Lithunians are entirely Nordic, and form a large part of the superior fighters, while the Poles, White Russians and Little Russians are Alpine. The Cossacks are now mostly Alpine in stock. Through the Balkans, the population is prevalently Slav and consequently Alpine. In Greece, the race was formerly composed of Mediteranean stock led by Nordics, but this has been almost entirely overlaid by a people of Alpine extraction.

The Mediterraneans are found in their greatest purity in Spain and southern Italy. In the north of Italy the Alpines form the majority of the population.

While these races have blended to a certain extent in almost every country, yet they are still distinguishable. But, it may be asked, can any real differences in fighting ability be shown among them?

It seems reasonable to believe that there can; that fighting ability is in part an inherent trait, of which one race may have more than another. This is strongly suggested by a study of wild animals, in whom wildness and pugnacity are certainly germinal qualities, and not merely the result of training.

At the same time, ability in modern warfare is not wholly a matter of pugnacity. It requires likewise coherence, obedience, and a great mass of traits of mixed germinal and social nature. Two nations may be equal fighters for very different reasons: one excels in dash, as the French, another in tenacity and persistence, as the English. This complexity of the qualities that make up a fighting nation may again be paralleled in animals. The fighting dog is a specialized breed which is constantly selected for two very distinct, inherent qualities—the ability to take punishment and the ability to give punishment. The former quality, gameness, is the more common, and it is not difficult to get a dog which will allow itself to be chewed to death without a whimper and which will start back into the combat after every round of battle, until he falls from exhaustion and loss of blood; and which nevertheless can inflict little damage on his opponent. On the other hand, some dogs are born with what the connoisseur calls a "long, firm, even bite" but they are "forty-minute dogs"—after a little fighting they get discouraged and quit. It is the rare combination of the two qualities that makes the unconquerable champion who gets his picture in the *Police Gazette*.

In a similar way, it is certain that races differ in their inborn fighting ability, as well as in their training, morale, and other acquired traits. The directors of modern armies should take this fact into consideration.

At present there are available six distinct stocks in the United States,

THE NEGRO OFFICER OF HIGHEST RANK

Only three Negroes have ever graduated from West Point, and only one of them is now in the Army. He is Major Charles B. Young of the Tenth Cavalry. Major Young, who is now 55 years old, entered the military academy in 1884 and has served in various cavalry and infantry regiments. He reached his present rank in 1912. In general Negro regiments in the United States have been officered by whites, but in the Spanish-American war a number of volunteer Negro officers were commissioned, and after the war two Negro regiments, the 48th and 49th U. S. Infantry, were enlisted for service in the Philippines, captains and lieutenants being Negroes. At the present time a considerable number of Negro officers as well as enlisted men are being trained. Photograph from *The Crisis*. (Fig. 2.)

each one of which should be able to play some part in the great war. These six stocks are the Indian, the Negro, the Jew,[1] the Alpine, the Mediterranean and the Nordic. Each of these stocks is distinctly different from the others both in temperament and physique. A careful consideration of this fact would insure the utilization of every stock where it would be of the most value.

From the standpoint of either fighting men or agriculturists, the American Indian will probably never be very effective. Pure blooded Indians are now extremely rare. Officially there are 265,000 Indians in the United States at the present time, but of that number it is said that less than 100,000 have enough native blood in them to be called true Indians, while many have little or no Indian blood, although classed for various reasons with some Indian tribe.

As a member of a large unit of his own race, the Indian would be of little value, due to his temperamental peculiarities. In the early nineties 3,000 Indians were enlisted as regular soldiers, but the attempt proved a flat failure, and the Indians finally had to be released.

But in spite of the disappointing result in that case, the Indian has often been invaluable for work which is suited to his mental makeup, such as reconnoitering, scouting, or the making of a sudden foray. Under such conditions he is brave enough, but he is not amenable to discipline and the terrible trench warfare would soon wear him out, while tuberculosis would decimate this exceptionally susceptible race.

There were many Indians with Pershing's troops on the Mexican border, and they distinguished themselves there in numerous ways. Although entirely unmindful of subordination they proved themselves invaluable if allowed to do their work in their own way, and were used only for scouting purposes. It seems probable that they could be made use of in the present crisis, guarding the Mexican border, and thus releasing men more competent for work in Europe. Thus, they would not be taken far away from their homes, and could be returned there at any time necessary.

VALUE OF NEGRO TROOPS

Negro soldiers have distinguished themselves on several occasions, and those that secure places in the ranks nearly always prove satisfactory. There were 178,975 Negroes in the Civil War on both sides, and although they were not extensively in action, they performed very creditably. Along the Mexican border, the work of the colored troops is well known, and their famous rescue of the Rough Riders at San Juan Hill is another example of their gallant bravery.

Heretofore Negro troops have been officered almost entirely by whites, but a training camp has been established at Fort Des Moines where subaltern commissions will be given to the best of the 1,200 Negroes who are now in training. The deportment of the men at the camp has been admirable, and has drawn favorable comment from many sources. There may be some difficulty in locating training quarters for the Negro troops where there will be no danger of conflict with the whites of the vicinity.

Enrollment of a large force of Negro soldiers is made difficult by the physical defects of the Negro race. Prominent among these is tuberculosis, a white man's disease to which the Negro is particularly susceptible here, out of his element and in what is biologically a white man's country.

A still more serious problem from a eugenist's point of view is presented by syphilis, which was made ground for exclusion from the National Army. It cannot yet be told with certainty just what effect this provision will have. A member of this association writes from Georgia:

"I am a member of the Board of Examiners here, and have been impressed with the greater number of rejections among the Negroes, and especially for syphilis and heart disease. Of course we physicians know how prevalent syphilis is among them, but I was not prepared to expect so

[1] Historically, the Jew is a blend of Mediterranean and Alpine.

many rejections for heart disease." This defect may, of course, be a result of syphilis.

NEGRO COMMISSIONED OFFICER.

Heretofore, Negro troops have been officered almost entirely by whites, but a training camp is now established at Des Moines, where 1,200 picked Negroes are being tried out, the best of them to get subaltern commissions. Dr. Joseph H. Ward, pictured above, is typical of the new régime. If the Des Moines camp is a success, the lower commissions in all the Negro regiments should be filled by colored officers. (Fig. 3.)

From Alabama a member of the association reports that "about 22% of the Negroes had been rejected" in one section of a large city, "while over 30% of the whites had failed to pass the physical examination. Local doctors tell me that no exemptions are made either for syphilis or gonorrhea unless the disease has progressed to a point causing other physical defects rendering the person unfit for service."

Another member, in Mississippi, says: "There has been no greater proportion of rejections of Negroes than of whites for any physical disability or disease except in the case of tuberculosis. I would say further that I do not believe great weight could be given to any figures obtained relating to the rejections because there is a certain tendency at least among southern physicians to discount a Negro's complaints and it is difficult to recognize such a disease as syphilis in any except the early stages."

AMOUNT OF INFECTION

The most reliable figures available are those of Major Vedder of the Surgeon General's Office[2] whose extensive application of the Wassermann test to applicants for enlistment convinced him that 50% of the Negroes of this age and class were syphilitic, as compared with 20% of the whites. If the more stringent examination given at the cantonments leads to the exclusion of all syphilitics, it will have two very serious results: (1) it will exclude many white soldiers who, if cured, would be of much value; and (2) it will exclude a much larger number of black soldiers. Not only are these Negro soldiers needed, but their exclusion means in many cases that additional Nordics must be called up to take their places, thus throwing an unduly heavy burden on the old American stock, and crippling the nation by drawing away men who are needed at home to perpetuate the industrial machinery which is as important in modern war as is the army.

If all syphilitics who are not otherwise unfit for service are enrolled in separate battalions, cured, and then called to the colors, the country will gain immensely. If the announced intention of the War Department absolutely to exclude syphilitics is really carried out, it may well be held in the

[2] *Therapeutic Gazette*, May 15, 1917.

future to be one of the great mistakes connected with the conduct of the war in America.

Negroes from the French colonies and Sikhs and Gurkhas from British India have been used to some extent in Europe, but although they proved courageous fighters in attack, they did not take kindly to remaining in the trench to be shot. The small Gurkha had a knack of leaving his trench, and worming his way to the German line, where he would tap on the ground with his big knife. When the German whose attention was attracted by the noise would peer up over the edge to investigate, the Gurkha would neatly sever his head. Such fighting appealed to the Orientals, but proved too dangerous for the modern type of warfare, and most if not all of the Gurkhas have been sent back to India.

THE JEW AS A FIGHTER

Although his race is numerically small and commonly characterized as peace-loving, the Jew seems to demand special attention. While forming but 2% of the total population, the Jewish race contributed more than 6% to the various military organizations of the United States in 1915. About 4,000 Jews fought in the Spanish War. At present Rear-Admiral Strauss, a member of that race, heads the Naval Bureau of Ordnance. The Jews do not seem to furnish as many officers as do other races, but in the rank and file their work has been excellent. Many officers who bear German or American names are of Jewish extraction, although they may have become so thoroughly assimilated as to have changed their names. There are more than 2,000,000 Jews in the United States.

But a vast majority of the soldiers will be of distinctly Nordic stock. The Nordics, upon whom the stability of the American nation has ever rested, are those who will be killed in largest numbers. This inevitable result of the war cannot but have a far-reaching effect on the nation as a whole. A vast number of men who are superior, both physically and mentally, will be killed or severely wounded, and many thousands will come back crippled by disease, or will have passed the age when they are likely to marry, or will have developed nomadic traits formerly inhibited, and for one of these reasons will never reproduce. Many of those who fight in the trenches will never pass on to offspring those superior attributes which have made their possessors the pride of a nation.

The European war has shown that all races fight well if properly led. The European armies are undoubtedly led by Nordics to a much greater extent than is popularly supposed, and America's armies certainly will be almost entirely officered by Nordic stock. It is not wise to let the losses of the war fall too heavily on any one stock of the nation, but as things now stand, the Nordic will bear most of the loss, because he is physically fit, generally has fewer dependents, and because the Negroes and aliens will, for various reasons, be frequently eliminated from the draft. It would hence be wise to take special pains to see that each stock contributed its quota. There seems to be a good chance of using the aliens in some line, and except for the exemption of syphilitics, there seems to be no reason why the Negro should not eventually take his part of the burden. There are lots of good fighters in the United States, and a place for each of them. Let each be in his place.

Increase in Divorces Follows War Marriages

Eugenists have pointed out that an increased number of hasty and ill-considered marriages constitute one of the dysgenic features of war. Sexual selection in such cases is not as good as if it were more deliberate. This contention seems to be borne out by the fact, mentioned in London correspondence of the Associated Press, that there is a large increase in the number of divorce cases now filed in that city. Many of these divorces are recognized, the dispatch says, as being the outcome of hasty war marriages.

PSYCHOLOGY AND THE WAR

Emergency Stimulates Practical Work and Application of Science Rather Than Development of Theory—New Views of War—Probable Changes in American Institutions—Need for More Research on Man's Inherent Traits[1]

G. STANLEY HALL
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RASH as it may seem to draw any lesson as yet from the present war, in which the great Nordic race which embraces the dominant elements in all the belligerent nations is committing suicide, the following points, which can be only hinted at in my twenty minutes, seem to me worthy of consideration here.

Mr. Hafner, through whom most of us receive our foreign periodicals, writes, "About one thousand French and German scientific publications have suspended as a result of the war, and about half of those that remain have been issued less frequently or in reduced size." They have also suffered in quality because so many collaborators doing the best work have been sent to the front, and many of them wounded or killed. About all the research being now carried on is in the medical field and in hospitals. Since April last, practically all continental publications have been kept out of this country. This affects not only our journal clubs but cuts off from us the stimulus of European thought, so that we are now the only great country in the world where research can go on as before.

Last month I asked and obtained the responses of representative authorities of all the twenty-four universities in the American Association concerning this situation. The responses were very diverse. One prominent university president amplified the view that it was high time and would do good for America to be weaned from its European alma mater. Another held that the cessation of importation of intellectual goods made in Europe would cause the culture level not only in academic departments but throughout the world to sink to a lower level. Most, however, held that this shortage will be a new and serious responsibility upon American scholars to make it good, that the present situation is a loud, clear call to independence, an opportunity for new leadership, that it should result in higher standards of originality and increased output of investigation, that the war opens opportunities to American universities as great as it has afforded to certain industries here, and that we should emulate the latter in devising new methods and in vastly enhancing output. If we only have the vision, the war will bring here a great advance in culture. The new Research Council of the National Academy and the Committee of One Hundred, with their splendid if, as yet, unrealized program, indicate that we are at least making a feeble beginning to respond to the situation. A vast deal has been said and written about research here within the last eighteen months, and there is every prospect that it will have at least enough, let us hope not too much, organization.

AMERICAN PSYCHOLOGISTS LEAD

As for psychology, whether we regard the quality or quantity of work done here in every field, all the way from introspection to behaviorism, including the study of animals, children, normal and subnormal, anthropology, especially as represented by our Bureau of Ethnology, the work in tests, scales, in stand-

[1] This address was prepared for the twenty-fifth anniversary of the American Psychological Association, New York, December, 1916, and is reprinted from the first issue of Dr. Hall's interesting publication, the *Journal of Applied Psychology* (March, 1917).

ards, and, indeed in about every domain of psychology (unless we except psychiatry, where most work worth while that has been done has been inspired either by Kraepelin or more lately by Freud), I believe we are quite ready to meet this call in the field of both pure and applied psychology, provided only we escape the obsession of finality in either method or result and realize that psychology is just beginning, the best things are yet to be found out, and that its difficulties and obscurities are the twilight of dawn and not that of evening.

2. Another effect of the war upon psychology that now seems probable is to lay stress upon applied as distinct from pure aspects of research. For two and a half years, practically all the leaders in most of the physical sciences, particularly physics and chemistry, have ceased to advance their science as such and have been absorbed in making it immediately serviceable; while even in the most humanistic fields culture has yielded to *Kultur*. The criterion of values in science is now what it can do pragmatically, in the Vaihinger sense. Talent of the order of Edison or Burbank has taken precedence over that of men like Helmholtz and Weismann, and the work of the latter is transvalued by the test of utility. The war has given the world its greatest lesson in scientific efficiency. Just as Russia in the war with Japan did not begin to realize how far the latter country had moulted all its pre-Meiji, and indeed all liberal culture, and focussed its entire energy upon practical efficiency, so none of the Entente Allies, least of all England, realized how far Germany had gone in casting off the culture of half a century ago, and in almost a single generation acquiring a new soul that made it, instead of the least, the most hard-headed, practically effective nation the world has ever seen, with hardly a vestige of the old, speculative, sentimental traits of the days before 1870. As pure chemistry failed to appreciate the value of the formula for making nitrate, which Germany had secretly bought from its Norse discoverer, and which enabled it to produce 300,000 tons of ammunitions during the first year of the war, at one-third its cost to the Allies, so its tests of the senses, motility, fatigue; its establishment of distinct digestive, respiratory, muscular, and nervous types; its temibility tests, which eliminate from the ranks both on donning the uniform and after every wound, thereby greatly reducing liabilities to panic; the French tests and assignment of men to infantry, cavalry, artillery, aviation corps, etc., according to the standard types of McAuliffe, Segaud, Thooris and Sorel, have shown how immediately serviceable psychology could be made in a new field. Already enough of the carefully guarded military secrets of these tests for specific lines of military service have leaked out to suggest why the German and French armies are so much more effectively organized than the English and Russian, and to show that applied psychology can render the most valuable service. We see with mingled admiration and dismay to what lengths Germany will go in applying all the latest knowledge in every field, not only in industry, but municipal and social organization, and even in eugenics, in ways often far beyond the reaches of the old morality.

THE STUDY OF HUMAN NATURE

Corporation schools, which here in the last four years have come to represent the advanced line of vocational discrimination and guidance, have already demanded of psychology vastly more knowledge of character and its traits than it has yet attained; and this has led, as we all know, to very many tables of human qualities, that are, some more, some less scientific, and premature, so that we can only very imperfectly and tentatively answer all the questions that business is now putting to us. So the war has still more urgently called upon psychology to do things it was not ready for, which had to be done extemporarily and as best they could by intuition. In both fields the call is so loud and insistent that it seems to me every psychologist should be able to give some reason if he does not do what in him lies to a better knowledge of man and life under

modern conditions, even if he has to break in some degree from his own lines of work, in order to help in the supreme problem of diagnosing each individual, and steering him toward his fittest place, which is really the culminating problem of efficiency, because human capacities are after all the chief national resources. In conning only a few of the some three thousand books and pamphlets on the war our library has made a specialty of collecting, only one topic has impressed me more than the literature that enumerates the various things which psychology is doing or can do, not only for war itself, but for the new social and industrial order which characterizes the state of a nation in war. Must we not, therefore, infer that such facts as these suggest that we readjust the old differentiation between pure and applied psychology, and realize that research in the latter field may be just as scientific as in any other, and that the immediate utility of our results is at least no longer a brand of scientific inferiority?

3. We shall surely have a new and larger psychology of war. The older literature on it is already more or less obsolete from almost every point of view, and James' theory of a moral, and Cannon's of a physiological, equivalent of war seem now pallid and academic. More in point are the reversionary conceptions of Freund, Pfister and Patrick, that it is more or less normal for man at times to plunge back and down the evolutionary ladder, and to immerse himself in rank, primitive emotions and to break away from the complex conventions and routine of civilized life and revert to that of the troglodytes in the trenches, and to face the chance of instant death when the struggle for survival is at its maximum in the bayonet charge. Lahy, Crile and perhaps a score of others described, on the basis of much observation and insight, the stages of this recessional. First is the general perturbation at home when mobilization is decreed, the fraternization of all classes, normally more or less aloof; the rank credulities and superstitions that suddenly arise and spread by psychic contagion, often to the clearest heads and coolest hearts, on the basis of high expectant tension; the mad rumors, fears, suggestions, often so painfully acute that the call to arms is a relief.

A NEW LIFE

Second comes the parting from home and loved ones; the donning of the uniform and with it the *esprit de corps* of the Army; the intense activity of the training camp; the remarkable development of powers of effort and of endurance, which makes each often a marvel to himself, a power by which those from sedentary life often excel laborers and peasants; the games, songs, theatricals, often camp newspapers, in which phenomena we see instinct seeking to compensate, in Adler's sense, for a deeper but repressed anxiety. Life at this stage is so absorbing that the old life at home pales, and loved ones are thought of with surprising infrequency, and it becomes harder to write to them; the sudden setting up, physical and often moral, of flabby individuals, to sleeplessness, heat, cold and hunger, as the individual learns to draw upon his phyletic reserve, and is often surprised to find the largest drafts upon it honored.

Third, in the advance into the trenches, where silence and immobility are often necessary under the greatest excitement, breaking down many a nervous system, and when everything else, past and future, is forgotten in the struggle for present safety and physical comfort, the long confinement and constrained positions interspersed with digging, bailing water, with sometimes personal draftings to carry despatches or rescue wounded friends from the "hell-strip" between the most advanced opposing lines, the acute attention to the sound of projectiles and their explosion, it is no wonder that some grow mad and rush wildly at the enemy and to certain death, or else back to safety, while those with stronger nerves develop with amazing suddenness a callousness to danger, fatigue, hunger, discomforts, while we sometimes have the unique reaction of

sudden fraternization with the enemy which Kreisler has so well described.

Fourth, when the charge is called, some drop, fatigued and perhaps dead from exhaustion, while others who thought themselves spent marvel at the sudden development of utterly unexpected resources in their own systems. Here each faces his man intent only upon killing him and escaping from being killed himself. When this is all over the survivors frequently, and sometimes for days and weeks, live in an illusion that the charge is still on, and they cut, slash, stab imaginary enemies, while the same obsessions haunt their sleep, so that even the hospitals, a few days after the battle, are noisy with the imagined battle which still rages in the soul. Those who have once had this experience, too, we are told, should recover within the hearing of the big guns, lest these obsessions undermine their courage and make them cowards and panic-starters despite their will. Only very slowly do even the sanest come back to full realization of what and where they are, what doing, and only gradually do their friends, relatives and home conditions live again in their souls as the past validates itself in the all-absorbing present.

THE STRAIN OF WAR

Such, too, is the unprecedented strain of the present war, with its high explosives, the contractions of both time and space, poisoned gases, the fatigue and demoralization deliberately planned by each enemy by continuous day and night bombardment before the infantry advance, that it is no wonder that each belligerent has had to develop a new type of hospital for cases of shock due to these causes. All agree that the nervous system of the belligerents has never been subjected to such a strain, and many hold that this of itself will impair the quality of parenthood perhaps for generations. War is a grim and awful experiment upon human nature, but like vivisection, disease and insanity, it should be studied intensively to find its nature, cause, and, if possible, its cure and at least its function for the individual and society. The very voluminous data in this field now fairly cry out for more and better interpretation. Raw instinct, feeling and emotion, which are the very roots of human nature, are stripped bare of all their disguises. The motivation of war, however interpreted, is psychological, whether its cause be individual, social, economic, or religious. War is still regarded too much as panics and pestilences were before science explained and controlled them. Hence it is that we should welcome the suggestion lately made of a society planned, to be given an international organization, to study the psychological aspects of this war, selecting literature, making special observations, according to prescribed methods, synthetizing results from all fields, in order that in the end we may have some definite conception of what war really is, does and means. At least the vastness and abundance of the data should not cause them to be neglected, seem common or go to waste.

4. Will the war tend to increase collectivism at the expense of individual activity and initiative? It stands forth already as the most perfect example the world has ever seen of completely organized teamwork. The individual is only a cog in a vast machine. The subaltern and even the lower officer knows almost nothing, and indeed one high authority has told us that only three men in one of the leading belligerent countries know anything in regard to the general military plan; and very few attempt to understand what is going on in other parts of the line in any front. The rest obey literally, trusting in the wisdom at the top. They do much and perhaps have to face almost certain death in an enterprise that seems to them utter folly, and they have no consolation save their faith that the leaders know it to be for the good of the whole. This is necessary for all effective armies, but in citizens of an autocratic government it comes easier and is more complete than in those pervaded by the spirit of democracy.

This, of course, is one of the reasons why wars always favor autocratic, and are unfavorable to democratic, institu-

tions. This concentration of power often includes the civic community, commandeered, while personal liberty suffers from countless encroachments. So mechanized is war today that there is ever less opportunity for brilliant coups, acts of self-initiated heroism and daring. So, too, the *esprit de corps* of the Army is strong and rigid in enforcing its collective judgment and sentiment, while, if internationalism declines, patriotic and perhaps fanatical nationalism is incalculably strengthened. Thus it is no wonder that when soldiers are at last discharged and go back to civil and industrial life, they find it hard to readjust. They have lost positions to others who have gained while they have declined in aptness for their old jobs. Instead of the closer tie of companionship in arms there remains only that of fellow-citizens. They have grown used to taking orders, to being fed, clothed, cared for, and so find it hard to return to doing these things for themselves, and expect government consideration in the form of pensions, offices and other favors. They lean on the state that they have served, instead of learning to exercise their own individual powers. In all these ways war is unfavorable to the spirit of democracy and more favorable to monarchical tendencies. A few new and powerful leaders arise because a few men have learned to exercise command, while the masses have learned to obey. War is as necessary for monarchy as peace is for democracy. One over-emphasizes order, system, control; the other magnifies beyond bounds unrestrained personal liberty. Here is the issue of the present struggle. Germany never had a revolution such as in England and in France swept away the spirit and even the vestiges of feudalism, which Teutonic genius has conserved and transformed into something which at least the neutral world must admire. The least governed people can perhaps best understand the most governed, and yet here our psychology fails to recognize the fact that it is prepersonalities that have made history, and that it is their synthetic organization, one with another, that has created civilization and culture, and that if these elements or units in the body politic, social and industrial, have their freedom repressed according to any wisdom the wit of man has yet devised, the whole of which they are members is sure, sooner or later, to lose the all-originating power of free and progressive development. Despite the penalties of freedom, such as license, sometimes degenerating to vice and crime, despite disorder, crude, often unsuccessfully and at best oft-repeated trial and error methods, if we believe in man and in a future that is to be greater than the present, we must believe that the American way will lead mankind to an ever higher goal of evolution and emancipation from the countless repressions that dwarf and stunt him in the home, the school, church, industry and state. The German superman is for the people an irridescent dream evolved in order to compensate for the fact of over-institutionalized life, and even the superstate there is the state that now is, while our superman and state is that which is to be when freedom has done its perfect work.

NEED FOR STUDY OF MAN

Finally, in view of all this, should we not in this country, along with all our other psychologizing, foster as something especially germane to the spirit of our institutions the study of individualities and racial and all the other very diversified groups which constitute our heterogeneous population, and do so not only for the development of anthropological science, but with the ideal of fitting each one's aptitudes of body, health, native gifts, traits of character, experiences and motor patterns, to just that occupation that best fits his own psychophysic organism, striving to guide each to that environment, industrial, social or cultural, in which his personality will find most incitement to unfold freely? Should not one of our ideals be to give each the kind and degree of self-knowledge that will make not only for maximal self-reverence and self-control, but for maximal freedom and the most efficient life? If a democracy achieves greatness

it must be not by the method of regimentation or any kind of organization imposed from without, but by finding the place in life for which each is best fitted. Must we not study individuals more than we study vocations, and thus perhaps some day may not the very apex of democratic society be found in its psychology, charged with the responsibility of seeing to it that the best powers of every man are discovered, developed, and put to their highest use?

Women's Separate Colleges Are Losing Ground

As the marriage rate of graduates of women's separate colleges is uniformly very low, it is interesting to the eugenist to note that colleges of this type are not holding their own, of recent years. "Fortunately," says Roswell H. Johnson ("School and Society," 1917, p. 679), "the percentage of women attending coeducational colleges is growing very rapidly. From 1895 to 1902 the number of students in separate colleges for women increased from 14,049 to 15,544, while the attendance of women in coeducational colleges increased from 13,940 to 23,216. If we exclude Roman Catholic colleges, the percentage of coeducational colleges grew from 30% in 1870 to 72% in 1902. These figures may be in part owing to the attitude indicated by graduates of separate colleges whom I have heard deplore the separateness."

Money Not Enough to Save Child Lives

The payment of maternity insurance or benefits has often been mentioned as an effective way of decreasing infant mortality. Such payments are now made in Great Britain but the London *New Statesman*, reviewing recent statistical reports, says that while they have made the price of midwifery go up, they have not had any effect on the infant mortality. This has, indeed, decreased during the war, but it is declared that no connection appears between infant deaths and the payment to poor mothers of sufficient money to meet the expenses of confinement. The *New Statesman* thinks the infant mortality is most closely related to overcrowding. It is quite likely, however, that this is merely symptomatic, and that the fundamental cause of the infant mortality is in a majority of cases inherited weakness.

A Decrease in American Intelligence

Possibility of a slow fall in the average intelligence of American towns appears from a study made by Prof. Rudolf Pintner ("School and Society," 1917, p. 597). He reports on a survey made of a town in the middle west (presumably Ohio), with 913 inhabitants. There were 154 children in the grade schools and all of these were examined by means of mental tests. Only one very bright child was discovered; there were 94 with a mental index below 50 and 60 who were at 50 or above. The average mentality of American children of corresponding ages is 50. The median of all the children tested was 40, an indication that they are below the average. It is significant that the American population of the town was found to be steadily decreasing, through race-suicide, while the brighter high school graduates usually leave town in search of greater opportunities. The town, therefore, deteriorates each year, in the average of intelligence—a deterioration which many eugenists think would be shown, in a less degree, could the necessary measurements be made of the mentality of the nation's entire population.

THE BLIND CAVE FISH

A Classical Problem of Evolution—Many Theories to Account for Its Loss of Eyesight—Cave-Darkness Probably Allows Unfavorable Variations to Survive—Life Habits of the Fish

OF ALL the strange creatures that live in subterranean waters, none is more familiar than the blind fish.[1] Fig. 4 shows one of the most commonly known, and perhaps the most interesting, of the blind fishes, that inhabit the Mammoth Cave of Kentucky.

This fish (*Amblyopsis spelaeus*) attains a length of 5 or 6 inches when adult, and varies in color through several shades of light pink and white. In general shape, it resembles a minnow of equal size. Such a comparison holds true only for general appearance, however, as upon closer inspection a multitude of adaptations are to be seen.

The eyes in most specimens have entirely disappeared, so far as can be seen by external examination, although in many instances dark spots may be detected where the eyes ought to be. The structure of the vestigial eye differs greatly in different individuals, but a microscopic examination will always reveal some traces of the organ. In some specimens, an external eye is found, presumably a throw-back to the original condition.

It has generally been stated that Amblyopsis brings forth its young alive, but it now appears that such statements are based on ignorance. The eggs issue from the oviduct and lodge within the gill cavities of the female. It is probable that they are fertilized in that situation, as unfertilized eggs are often found there. The young fish are also guarded in the cavities for some time. If the eggs do not hatch, they remain in the gill cavity until they disintegrate.

The young are blind when hatched, and presumably when in an embryonic stage as well, and remain so throughout the duration of their life, irrespective of their surroundings. Various experimenters have taken very young fish or even eggs, and raised them in bright light, but in every case the environment has proved to have little or nothing to do with any development of the eye.

Amblyopsis spelaeus is found in various localities in Kentucky, Indiana, Michigan and Ohio, nearly always in pools in the limestone caves of those States, but is occasionally found in deep wells, and even in open water, where it is possible it may have been brought accidentally. It probably lives to a large extent on small organisms which may be invisible to the eye, but it also eats small arthropods when such are procurable, and in captivity will even eat small pieces of meat.

DEPENDS ON SENSE OF TOUCH

Since the fish is entirely devoid of sight, it must necessarily depend upon other senses for securing food, and probably the most important of these is the sense of touch. Tactile papillae, which are akin to the antennae of insects, but are generally like small ridges in the skin, are located profusely on various parts of the body, especially around the mouth and head and on the ventral fins. If, when swimming close to the bottom, the fish touches some substance with its ventral fins, it will nearly always stop and investigate. It seems that it is unable to detect whether the substance is edible or not by the fins, but the papillae around the head are so developed that they can tell the difference between edible and non-edible substances.

It has been stated that the "hearing" of this fish is remarkably acute, but here again it appears that this acuteness

[1] The most detailed account of cave fish is that of Carl H. Eigenmann (Cave Vertebrates of of America. *Carnegie Institution of Washington Publication* No. 104, 1909).

BLIND CAVE-FISH AND ITS NORMAL RELATIVE

Above is a fish from the Mammoth Cave of Kentucky, which has no eyes but merely a slight discoloration of the skin at the point where the eyes ought to be. To take the place of sight, the fish depends on the sense of touch even more than blind people do—it is said in this way to be able to determine whether a certain object with which it comes in contact is or is not edible. If a fish is going to live in cave-darkness, eyes would obviously be of little use to it; but the exact nature of the process by which the eyes disappeared has long been a bone of contention among students of evolution. Below is a minnow, probably distantly related to the blind cave-fish. It may, therefore, give some idea of what the cave-fish looked like before it lost its eyes and became modified in other ways to meet the conditions of life in underground waters. Photographs (much enlarged) by John Howard Paine. (Fig. 4.)

in detecting certain kinds of vibrations is due to the papillae. Experiments have proved that the ears are poorly developed, and the fish is unable to perceive most sounds, but the papillae are so sensitive that any slight disturbance of the water is instantly noted, and since the fish are confined almost entirely to pools, any such disturbance is sufficient to warn them that the vibrations are the result of something unusual. The fish is entirely scaleless, these papillae evidently replacing the scales. The ear itself is apparently normal, and while it is evidently not used to detect sound, it probably serves to maintain equilibrium.

The fish is believed to breathe through

the skin, but it apparently needs little oxygen, as one can keep a large number of them in a pail of water for some time without changing the water and they do not appear to suffer. When placed in an aquarium where there is a division into two parts, one light and one dark, the fish will always seek the dark. The optic lobes of the brain have degenerated greatly, but in other respects the brain shows little change. There are many other adaptions, but a sufficient number have been mentioned to indicate the changes which have taken place in this remarkable fish.

Fig. 4 also shows a member of the genus Fundulus, the killifishes, or minnows. There are more than a score of species in this genus, and the various groups include many different types, but this one is possibly distantly related to Amblyopsis and may give an indication of how the ancestor of Amblyopsis looked, and how the genus Amblyopsis might look today, if adaptive selection had not allowed the deformed members to establish the status of the species rather than the normal members. Such an evolution can be paralleled in some human societies where misfits are perpetuated and crowd out the normal population. A degenerate clan like the "Jukes" may thus take possession of a mountain valley and fix the tone of the whole population.

HOW EYESIGHT WAS LOST

The question of how the cave fish lost its eyes has long been one of the stock subjects for debate among students of evolution. Even to review the hypotheses that have been advanced would require a long article. They may, of course, be broadly divided in two groups: on the one side are the Lamarckians who think that the eye atrophied as the result of disuse and that the effects of this disuse were inherited, with cumulative results in each generation; on the other side are the Darwinians who look to some form of natural selection, acting on variation, to produce the observed result.

The natural method of deciding between the conflicting views would be by experiment, and a number of biologists have conducted experiments with such fish, but the results have in no case been conclusive, probably owing to the short time they covered, as compared with the long time in which the fish may have been undergoing evolution.

It is quite likely that various species have reached their eyeless condition in various ways, and that even on one species more than one cause has been operating to produce the absence of vision. There are at least two explanations which can be plausibly supported by modern knowledge of genetics.

1. It is possible that the blindness was produced rather suddenly as a result of hybridization, exposure to the action of chemicals, or some other powerful influence. Blindness can be experimentally produced in fish by these means. The fish once being blind, they wandered into a cave—or perhaps were in a cave when they became blind—and were able to survive because eyes were not of value in cave-darkness anyway. If they had stayed outside the cave they naturally would have perished. In this view the cave is not responsible for the blindness, either directly or indirectly; it merely preserves the fish who have become blind for some other reason. This is the explanation which has recently been advocated by Jacques Loeb,[2] among others.

2. The commoner explanation looks on the blindness as being of slower development, although not, as the Lamarckians supposed, produced by cave darkness. It is supposed that a number of normal fish got into a cave. Those with the best sight would find their way out; those with naturally defective vision would be unable to escape, and, remaining there, would perpetuate their kind. In the cave darkness acute vision would no longer be essential to survival. There being no predaceous enemies, the fish which could not see at all would have just as good a chance of surviving and leaving

[2] The Organism as a Whole, Chapter xii. New York, 1916.

offspring as would the one with fairly good sight. Now in all the fishes, it is supposed, variation of the eye is constantly taking place, and variations which tend to spoil it are much more frequent than those which tend to improve it, on the general principle that an accidental change is vastly more likely to harm a complicated mechanism than to add to its perfection. In the open these unfavorable variations are constantly being weeded out by natural selection; in the cave they are allowed to survive, and hence the whole population of cave fishes eventually comes to lack eyes, these organs having been deteriorated by unfavorable variations, generation after generation.

Both these explanations require to be supported in detail by numerous additional hypotheses, and they are not beyond criticism. They are, however, probably the most satisfactory that have been so far suggested.

Advice for Nervous People

THE MASTERY OF NERVOUSNESS, based upon the re-education of self. By Robert S. Carroll, M.D., Medical Director, Highland Hospital, Asheville, N. C. Pp. 346, price $2. New York: The Macmillan Co., 1917.

In the stress of modern life, almost every man and woman at some time faces the problem of nervous debility. To help them meet this problem, Dr. Carroll has written a simple, sensible, practical book. It is not at all technical, but is intended solely for the layman, dealing exhaustively with right methods of eating, working, playing, thinking; with the emotional and the intellectual life. It should be helpful to many.

Dr. Carroll's treatment of heredity is very casual and not particularly clear. He appears to think that a man may, by overeating and the use of tobacco as well as by other excesses, damage his germ-plasm in such a way that his offspring will be born with impaired nervous system. Proof of this would be received with much interest by geneticists. However, a discussion of heredity is not an integral part of the book, and it would not be fair to lay too much weight on its shortcomings in this direction.

A Study of Men of Genius

GENERAL TYPES OF SUPERIOR MEN, a philosophico-psychological study of genius, talent and philistinism in their bearings upon human society and its struggle for a better social order. By Osias L. Schwarz, with a preface by Jack London and an introductory letter by Max Nordau. Pp. 435, price $2.50 net. Boston: Richard G. Badger, 1916.

It is not often that a book carries, in its own introduction, so fair a review as Dr. Nordau has written to Dr. Schwarz. He says, in part:

"Your study on genius, pseudo-superior man and philistine is in reality a pretext for invective against the average man who is, in fact, an average beast. Your indictment against that type is wonderful in its quaintness, raciness and overwhelming power. It compares favorably with the very best, most scathing satires on the miserable creature man that I know of in the world of literature. But it is dogmatic, not scientific, it is subjective and cannot claim that calm objective argumentativeness that carries with it conviction even to obtuse or oppositionally oriented minds."

The present reviewer indorses Dr. Nordau's judgment but would add that he spoke too mildly when he wrote to Dr. Schwarz, "Your analysis of hereditary influences in the formation of genius is hazy." No one should expect to get any real anthropological data from the book. Nevertheless, it is stimulating, and any thoughtful reader will enjoy dipping into it.

SKUNK BREEDING

American Mammal Gaining Recognition as a Valuable Friend of the Farmer and a Producer of Desirable Fur—More Than 500 Skunk Farms Now in Operation—Several Mutations Found

HERETOFORE usually regarded as a noxious pest, a destroyer of birds and their eggs, as well as the agent of frequent depredations on the farmer's hen roost, the skunk is now being recognized as one of man's valuable allies, not only as a relentless destroyer of farm pests, but also because of his increasing value as a fur producer. His worth in the fur market is a recent development, but already more than five hundred people in various parts of the United States are engaged in breeding skunks, either selling the pelts to furriers or disposing of the live animals to others who seek to start fur farms.

More than a dozen States have already passed laws protecting the skunks and probably, as the unusual economic value of the animal becomes better understood, similar laws will be passed in every State, affording fuller protection to one of the farmer's best friends, and one of the most valuable of American fur bearers. The muskrat, mink and skunk are the only three fur-bearing animals which are still fairly abundant in the United States, and of these the mink is already in danger of extinction, due to the fact that it breeds but once a year and has been thinned out greatly by close trapping.

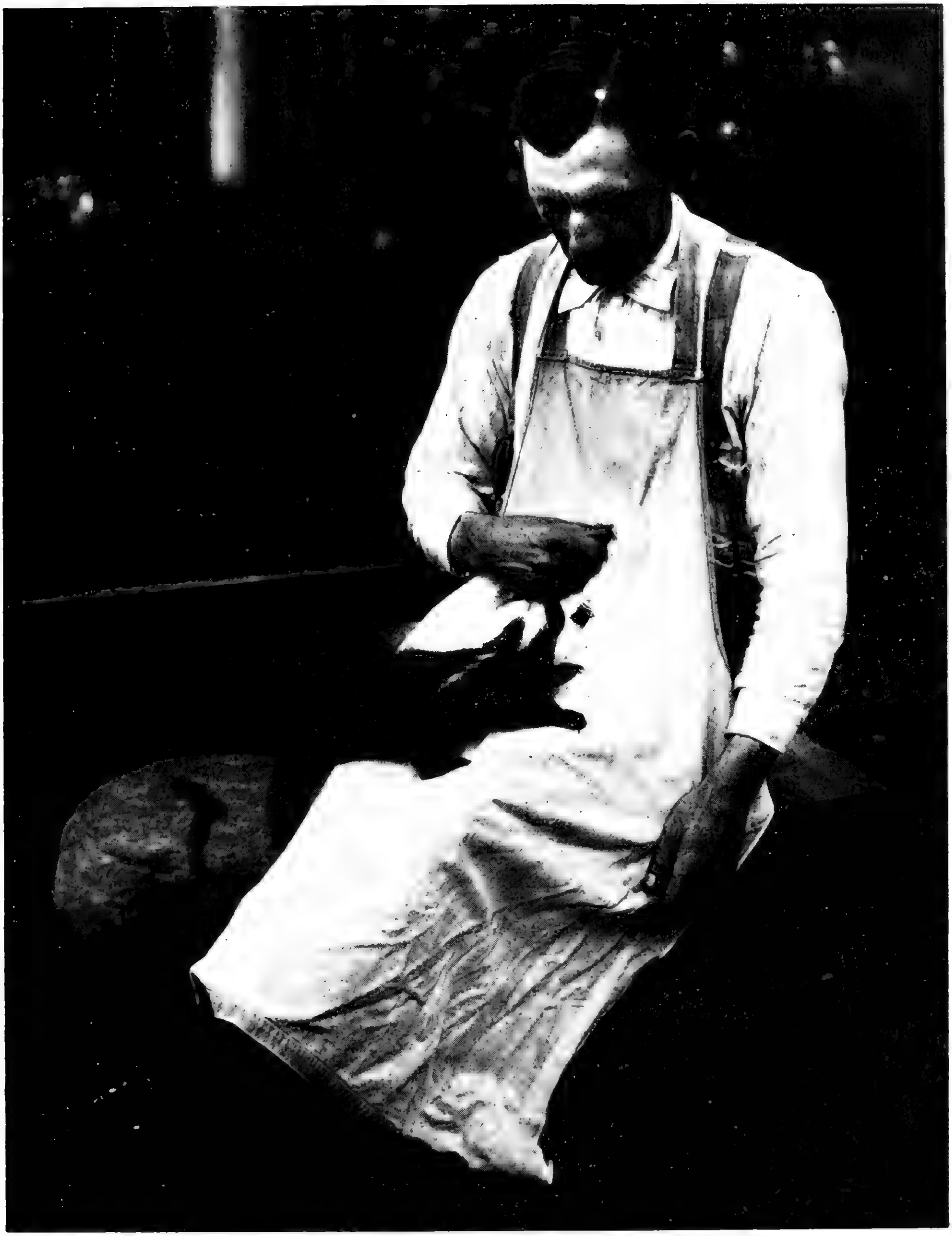
Skunks are divided into two general classes, the spotted and the striped, by those raising them for fur. Zoologically, many species, subspecies and races are named, but since the breeders recognize two classes in their work and cross their animals freely without regard to scientific technicalities, the commercial classification will be sufficient for this note. The spotted skunk is generally too small for profitable fur breeding, and due to the peculiar coloration, its pelt is not so highly prized as that of the striped skunk. When the pelt of the spotted skunk is placed on the market, it is generally called "civet" and under this name it has enjoyed a decided vogue for the past few years. In spite of the popularity of "civet," however, the striped skunk is still the one most sought for commercial purposes, the value of the pelt depending on the amount of black it contains. A pure black pelt is worth about $10 on the present market, the color of the skins thence ranging through the intermediate splotchings to pure white. Ordinary skins are worth from $3 to $6 apiece when raw.

COLOR INHERITANCE

J. A. Detlefsen of the department of genetics, University of Illinois, has found a number of mutations which are valuable for their types of fur, and is breeding these and making a study of color inheritance in the skunk. It seems probable that skunk breeding will eventually be carried out in a much more scientific fashion than it is now, for some breeders state that already they have been able, by several generations of careful selection, to produce pure black animals which appear to breed true to type.

The most objectionable feature of the skunk as a pet has been its overpowering scent, with which every country-dweller is familiar. The scent is ejected from two oval sacs located beneath the skin just below the tail, which are covered with such powerful muscular tissue that a vigorous skunk has been known to eject the fluid as far as 15 feet, although 6 to 10 feet is a more common distance. It is often practically impossible to remove the odor, especially from the clothing, although gasoline is of value as a deodorant, while chloride of lime likewise works very effectually.

Most skunk breeders remove the scent glands when the skunk is quite young by a simple operation which is



THE SKUNK IS NOT NECESSARILY TO BE FEARED

It is an unpleasant neighbor when annoyed, but otherwise a desirable one. Few mammals are more valuable to the farmer in destroying vermin. In recent years, skunk fur has been much in demand, and more than 500 breeders in the United States are now raising the animals in captivity, while geneticists are working to produce superior color varieties. Photograph by Brown and Dawson. (Fig. 5.)

easily performed after a little practice. But one breeder has found this unnecessary and claims that with proper care no trouble need be met with from the scent. He finds that when skunks are raised in captivity and treated with kindness they no longer throw their scent. To prove the point, he is now raising skunks *au naturel*, and is shown in Fig. 5 handling them without the least apparent danger.

Skunks seem to enjoy living near man and often build their nests under flooring which is near the ground. They like to bathe frequently, but will not swim unless forced into deep water. Some of the smaller varieties climb trees. The skunk frequently inhabits some hole in the ground, either digging it with his strong plantigrade feet, or more frequently selecting a hole which has already been dug, and from which he may find it his duty to oust the erstwhile occupant.

Skunks breed but once a year, generally in the early spring, and have from six to twelve in a litter sometime in May. The new-born skunks do not open their eyes for some weeks, and are at first hairless in most cases. They follow their mother for six months, at the end of which time they are adult, and breed in their turn the following spring. Although many are still caught by trapping, the number thus obtained would not begin to fill the demand for pelts, so breeding is becoming more and more a profitable industry. Breeders expect that prices for pelts will more than double in the next few years.

Iowa Establishes Child Welfare Research Station

The State of Iowa is to have the credit of establishing the first Child Welfare Research Station. The recent act of the legislature authorizing the appropriation of $25,000 a year for this purpose inaugurates an attempt to do for human life what animal husbandry experiment stations have long done for the conservation of animal life. The work of the station includes six divisions, as follows: (1) Heredity and prenatal care, focussing the resources of the rapidly growing science of genetics upon the problems of parenthood in Iowa; (2) Nutrition of the child, investigating and combating the causes of infant mortality in the State; (3) Preventive medicine, including the study of infant diseases, preventive dentistry, hygiene of the nervous system, and the establishment of standards of normal development for Iowa conditions; (4) Social surveys, giving a basis for legislation on birth registration, sanitary codes, industrial regulation and school attendance; (5) Education and morals, with especial attention to the types of education that may be utilized by parents before the children are six years old; (6) Applied psychology, involving studies in mental health and growth. There is undoubtedly a splendid field for research in each one of these divisions, and the State of Iowa is to be congratulated on engaging in such a beneficent and far-reaching enterprise.—*Journ. Educational Psychology.*

Underfeeding as a Cause of Sterility

One of the most important investigations required in connection with eugenics is of the causes leading to sterility. It is generally believed that overfeeding will produce at least temporary sterility in female animals, and in the *Biological Bulletin* (August, 1917), Leo Loeb publishes experiments with guinea-pigs which show that underfeeding will also lead to the sterility of the female. The possibility that the same cause acting in man might produce the same effect adds interest to the recent announcement from Berlin, that newly-married couples are to be given a double allotment of food during the first six weeks of their married life.

THE BIRTH RATE OF METHODIST CLERGYMEN

Prominent Churchmen Nearly All Married and Have More Children Than Other Men of Similar Education and Social Rank, Despite Their Small Salaries—Marked Evidence of Birth Control

THE EDITOR

THE influence of religious ideals in maintaining a high birth rate has often been discussed by eugenists, but with very few facts to go on. It has sometimes been assumed that religion is antagonistic to the idea of birth control, and that the families in a particularly religious section of the population are larger than the average.

The present paper reports a study of the families of 1,986 persons prominent in the Methodist Church in the United States. Most of them are clergymen. It demonstrates that a remarkably high percentage of them are married, and that the birth rate is considerably higher than among other people of an approximately equal degree of education and social standing, notwithstanding the fact that the average Methodist minister's salary is probably under $900 a year. It is thus seen that religious ideals do have some effect in increasing the birth rate. However, it is a mistake to attribute too much importance to such influence, for the economic influence appears to be more important in determining the size of family. There is marked evidence of much voluntary birth control in the families of these prominent Methodists, and as a whole the group is barely reproducing its own numbers.

The data are taken from "Who's Who in American Methodism," compiled by Carl F. Price and published in 1916. The biographies in this book were furnished by the subjects themselves, and state, among other things, the date of birth, date of marriage, and number of living children. Between 1 and 2% of the individuals included are women, who have been treated as men in tabulating the statistics. This undoubtedly introduces a small source of error, but it is probably pretty evenly distributed.

It appears from a study[1] of the biographies in this book that marriage is, as it is popularly supposed to be, almost universal among clergymen. The percentages are as follows:

Never married	2.56%
Married once	83.98
Married twice	12.59
Married thrice	.84

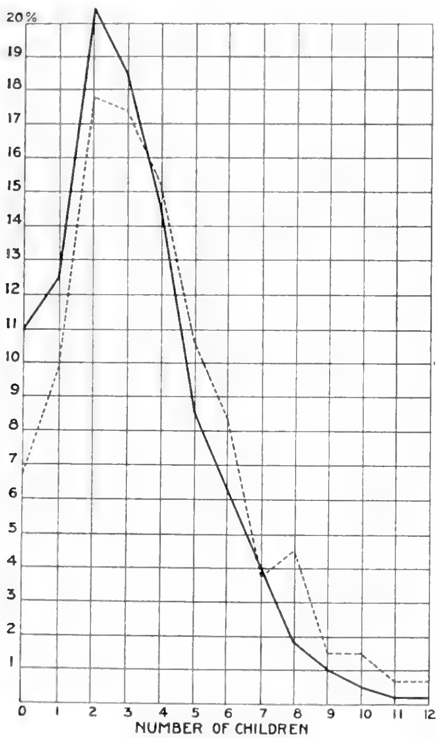
The small number of single men is remarkable in comparison with Harvard and Yale graduates, of whom from 20 to 25% are celibate. It confirms the popular idea that it is impossible for a clergyman to remain unmarried. Some of those listed as single may yet marry, reducing the percentage still further.

MARRIAGE AT EARLY AGE

The early age at marriage is also remarkable, considering the fact that a young clergyman gets a very small salary, and that other men of his class put off marriage much longer, pleading the expense of marriage as an excuse. The Methodists here considered most frequently marry at the age of twenty-four, and the great bulk of them are wedded before they reach the age of thirty. If a line is drawn at twenty-six years, it is found that just as many marry before as after this age. But at twenty-four the ordinary college man has been separated from his alma mater only a few months. It is evident that a

[1] The data were extracted and largely tabulated by W. L. Altman, of the American Genetic Association. On leaving to take up military service, he turned them over to the editor.

very large number of clergymen must marry shortly after they leave the theological seminary—probably soon after they receive their first appointments. This is doubtless explainable by the fact that ministers as a class are, by reason of their more or less emotional



METHODIST FAMILIES

The solid black line shows the distribution of size of family among prominent Methodists who married but once. The number of childless households is seen to be 11%, and the most frequent size of family to consist of two children, such families making up more than 20% of all.
The dotted line shows the size of families among prominent Methodists who married twice. It might be expected that two women would bear considerably more children than one women, but this is true here to a very limited extent. The most frequent family still consists of two children. (Fig. 6.)

temperament, "marrying men:" that the scope of sexual selection is wide for them; and that a clergyman finds a wife almost a necessity in his pastorate.

Confining the study to those who married only once, it appears that they married at various ages in the following numbers:

Age	*No. married*	*Age*	*No. married*
17	4	37	12
18	10	38	10
19	12	39	6
20	33	40	6
21	73	41	10
22	89	42	2
23	137	43	2
24	174	44	4
25	159	45	3
26	163	46	1
27	153	47	4
28	135	48	1
29	129	50	2
30	91	52	1
31	69	53	1
32	50	56	1
33	48	58	1
34	30	60	1
35	22	65	1
36	18		
Total			1,668
Mean			27.28 years

To calculate the birth rate from these marriages, all were rejected which had not at least twenty years' standing in 1915, when it was assumed that most of the data in the book were compiled. This reduced the number of marriages to 1,512. The entire distribution of the birthrate from these marriages will be found in Table I (at the end of this paper) and is presented graphically in Fig. 6. It is evident that Methodist clergymen have tended to standardize the two-child family, which is so much in evidence among college professors and in other educated classes all over the civilized world. There are more families of two children than of any other size. It must be remembered, however, that all the children dealt with here are surviving children: they have at least passed the perils of infancy. If a line is drawn at 2.3 children, it is found that there are just as many families on one side as the other. This is a dangerously small birth rate, even for a net birth rate. The average is raised (to 3.12 children) only because there are enough large families to counterbalance the larger number of small ones.

Small as it is, this birth rate compares favorably with that of other men of

similar social status. J. C. Phillips[2] found that the average number of surviving children of Harvard graduates is 2.17 and of Yale graduates 2.18. If every married woman who demonstrates any ability to bear children brings three to a marriageable age (says Robert J. Sprague),[3] a race will barely remain in equilibrium. If the number of children is smaller than this, the race will decline in numbers. The class of Methodist clergymen is, therefore, just about reproducing its own numbers.

HOUSEHOLDS WITHOUT CHILDREN

The number of childless marriages, 11% of the total, is striking. Part of these are represented as childless in the returns because any children that were born had died before the book was compiled; therefore the actual number of barren marriages is less than here shown. How much less, it is impossible to say. If it be supposed that in one-half of such marriages, children were produced but died (a wholly arbitrary assumption), this would reduce the number of naturally barren marriages to 5.5%. A. O. Powys calculated, from the vital statistics of New South Wales[4] that in a population of Anglo-Saxon mothers of child-bearing age, not more than 2 or 3% are naturally barren; but conceivably a somewhat higher percentage would be barren in North America. It seems safe to conclude that absolutely childless marriage is very rarely desired by Methodist clergymen. Such barren marriages as are found are probably not the result of voluntary avoidance of children. The record of the Methodist clergymen contrasts in this respect with the record of Harvard graduates (decade of 1881–90) who show 23.4% of childless marriages, or of Yale graduates (21%).

But if the wives of Methodist clergymen are not avoiding motherhood altogether, they at least appear to be limiting their families to small size. The great preponderance of one-, two-, and three-child families at once suggests birth control. When an unlimited family all over the world tends to consist of at least five children, there is more than a coincidence in the appearance of so many two-child families among intellectual people everywhere.

Of course, these small families might rather be due to the inferior health of the mother, or to some other biological cause than voluntary birth control. The data do not lend themselves so well as might be desired to a decision on this point. It seems possible, however, to throw some light on it by a comparison of the families of those who married once with the families of those who married twice. For this purpose a separate count was made of all individuals who married twice, and whose second marriage occurred not later than 1900. This practically ensures that the family is now complete. No more children are likely to be born.

FIRST AND SECOND MARRIAGES

To make sure that both marriages existed long enough to be productive, the interval between the two marriages was noted. There were some surprising results—in a number of cases the interval was half a century. On the average, it was 11.5 years. The median line was eight years: that is, the second wedding came less than eight years after the first, in just as many cases as it came more than eight years after the first. Naturally, the first wife must have died several years before the second marriage. But, when all allowances are made, it is evident that the first marriages lasted long enough to make possible the birth of several children, while none of the second marriages had lasted less than fifteen years.

Now if the clergyman's small family is due to debility of his wife, and to that alone, then the man who has been twice

[2] Phillips, John C. A Study of the Birth Rate in Harvard and Yale Graduates. *Harvard Graduates' Magazine*, September, 1916, pp. 25–34. This comparison is probably too favorable to the Methodists, for they are scattered all over the United States, while the college graduates referred to are concentrated in the East, where the birth rate is probably lower than in the West.

[3] Sprague, Robert J. Education and Race Suicide. JOURNAL OF HEREDITY, vi, pp. 158–162, April, 1915.

[4] Powys, A. O. Data for the Problem of Evolution in Man. On Fertility, Duration of Life and Reproductive Selection. *Biometrika*, iv, pp. 233–286 (1905).

married ought to have a distinctly larger family than the man who has had but a single wife. It would not be twice as large, because (*a*) the first wife was physically weaker than the average, as witness her premature death, hence she bore fewer children or they were more frequently weak and died; and (*b*) the second wife was in some cases past the child-bearing age when she married.

It is impossible to say how much allowance should be made under (*a*), but a rough allowance can be made for (*b*). It is certain that in most cases a minister would choose as his second wife a woman somewhat younger than himself. The average minister was 27 years old when first married; if his second marriage was even fifteen years after his first, and his second wife only two years younger than himself, she would still be capable of child-bearing. If, then, all second marriages are excluded which took place more than fifteen years after the first, the total number of second marriages will be reduced by 30%. Hence, it seems reasonable to think that if the small families of clergymen are due to the debility of their wives, the man twice married will have at least 50% more children than the man once married.

If, on the other hand, the size of the family is limited voluntarily, in accordance with the minister's economic position, the children of a man twice married will be little more numerous than those of a man once married. The birth rate will be slightly increased, however, because even if a man has by his first wife as many children as he can afford to educate, nevertheless his second wife will desire the experience of motherhood. This is likely to add at least one more child to the family.

The foregoing speculations are not represented as conclusive. They are intended to show that numerous counterbalancing influences are at work on the birth rate but that, on the average, two mothers ought to produce a distinctly larger family than one mother, unless the husband limits the size of the family for financial reasons.

FAMILY LIMITATION SHOWN

What do the statistics show? On the average, a second wife *adds only half a child* to the minister's family. It is impossible to interpret this in any way except as showing that the size of these Methodist families is determined mainly by the intelligent plan of the parents, not by the capacity of the women to bear children. The Methodist clergy appears to offer a good illustration of effective birth control.

The extent of this birth control can be shown in another way. From a study of the marriages of *less than* twenty years duration, it appears that 1,000 Methodist clergymen's wives in the United States bear about 115 surviving children a year. In New South Wales, where there seems to have been little or no limitation of offspring when A. O. Powys collected his statistics, 1,000 Anglo-Saxon mothers bear about 295 children a year. The latter rate is gross and that of the American Methodists net, but as infant mortality is low in Australia, it must be concluded that the reproduction rate among Methodists is less than half the normal rate for Anglo-Saxon women. The causes of this 50% reduction are, of course, complex—it is not intended here to suggest that the low rate is wholly due to voluntary limitation, although it must be largely so.

If the available number of second marriages were larger, important conclusions might be drawn from a study of the childless families. Actually, any conclusions drawn can hardly be taken seriously. With this warning, it can be shown[5] that there are four times

[5] As 11% of the single marriages are childless, the chance that a clergyman will have no children by his first wife is $^1/_9$. The chance that his second wife will likewise be childless is $(^1/_9)^2$, or $^1/_{81}$. Making allowance for those cases where the second wife was possibly beyond the child-bearing age when she married, the percentage of childlessness among the twice-married is 4.9, when chance allows but 1.2%. If the various assumptions involved in this reasoning are valid, it must be concluded that three-fourths of the childlessness among the twice-married is either voluntary or due to the husband—probably the latter. But, as stated above, the numbers involved are not large enough to give the example any weight.

more childless families of clergymen who married twice than was to be expected. If hese figures have any validity, they suggest that the childlessness (where not due to the death of all children) is due to sterility of the husband and not to barrenness of both wives. It is to be hoped that someone who has records of a larger number of cases where two marriages were childless will test them by this method and throw light on the problem of involuntary childlessness—a problem of great importance to eugenics.

GALTON'S CONCLUSIONS

It would be worth while for someone to send a questionnaire to clergymen, and find out to what extent their small families are due to economic causes, and to what extent health is responsible. Sir Francis Galton's report[6] would seem to attribute a larger part to physical causes than has been done in the present paper. From a study of 196 eminent English divines, he reached the conclusion: "That they are not founders of families who have exercised a notable influence on our history, whether that influence be derived from the abilities, wealth, or social position of any of their members. That they are a moderately prolific race, rather under than above the average. That their average age at death is a trifle less than that of the eminent men comprised in my other groups. That they commonly suffer from overwork. That they usually have wretched constitutions, . . . ;" indeed, he is in another paragraph "compelled to conclude that robustness of constitution is antagonistic, in a very marked degree, to an extremely pious disposition."

Wretched constitutions do not seem so characteristic of the modern clergymen as they were of the divines studied by Galton. Perhaps the minister today is not so "extremely pious," or perhaps with very bad health he cannot keep up the work involved in a pastorate. At any rate, the facts presented in this paper all seem to indicate that the size of the family among the most prominent American Methodists is due more to voluntary limitation than to any other single cause.

With the low salaries paid to ministers, it is remarkable that the amount of limitation is not greater. The clergymen are making a larger eugenic contribution to the race than are most other groups of similar standing—a fact probably accounted for in part by their inherent emotional nature and in part by the influence of their religious idealism. If more adequate salaries would encourage a higher birth rate in the ministerial profession, it is earnestly to be hoped that the church will rise to the occasion.

TABLE I

No. of children in family	Once married		Twice married	
	No. of families	Per cent	No. of families	Per cent
0	167	11	9	6.8
1	189	12.5	13	9.9
2	309	20.4	25	18.9
3	281	18.5	23	17.4
4	221	14.6	20	15.1
5	130	8.6	14	10.6
6	94	6.2	11	8.3
7	61	4.0	5	3.8
8	28	1.8	6	4.5
9	15	1.0	2	1.5
10	9	0.5	2	1.5
11	4	0.2	1	0.7
12	3	0.2	1	0.7
14	1	0.06	....	....
....	1,512	....	132	....

All families of "once married" had a duration of twenty years or more. All families of "twice married" had a duration of fifteen years or more for the second marriage.

Mean family of "once married," 3.12, $\sigma = 2.06$.
Mean family of "twice married," 3.73, $\sigma = 1.32$.

[6] Galton, Francis. *Heredity Genius*, pp. 270, 274, etc. New York, 1877.

THE TOO-PERFECT MILKWEED

Its Method of Covering Insect Visitors with Pollen, to Insure Proper Cross-Fertilization of the Species, Appears to Have Been Carried beyond the Height of Perfection, so That it Now Defeats the Purpose for Which it is Intended

IN HER attempts at specialization, Nature is often startlingly successful, but there are a few instances, among both animals and plants, where this specialization has over-reached the capacities of the organism specialized, and thus the specialization has defeated its own ends. The classic example of this is, of course, the Irish stag, whose highly developed antlers enabled it to overcome its opponents in the struggle for existence. If the development of the horns had stopped at this stage, all would have been well, but the horns kept on increasing in size until they became so enormous that the stag was unable to support them, and the species finally came to extinction.

A more familiar, though less striking, case of adaptation carried too far is presented by the common milkweed or silkweed of the eastern United States (*Asclepias syriaca*), whose specialized flowers appear to have developed further than is really desirable. Although this over-specialization may be dooming the plant to eventual extinction, the milkweed is at present one of the sturdiest and most ubiquitous weeds in the eastern part of the United States, and so far certainly gives no evidence that it is losing out through any hypertrophy.

Due to the fact that it is never self-fertilizing, the milkweed depends entirely on insects for distributing the pollen from plant to plant. Evidently, if it was made too easy for insects to secure nectar, they would drink their fill and fly away without carrying much pollen. It was an advantage to the species to make the insect struggle in the flower, thus thoroughly covering itself with pollen which would be carried to the next blossom.

To assure a struggle on the part of the insect, the plant developed a sticky juice which exudes through the petals. This serves the double purpose of making the insect move violently in order to get away, thus bringing its feet and legs in contact with a large quantity of pollen, and also of coating the feet and legs with the sticky substance, so that the pollen grains would adhere more readily.

Thus far the plan would succeed admirably, but the specialization was not arrested at the height of its usefulness, but continued developing until many insects are maimed, crippled or killed by the action of the sticky substance, as shown in Fig. 7. Thus the plant appears to defeat its own ends by causing the insects to be so crippled that they are unable to carry on the work of fertilization as was originally intended, and furthermore, the large deposit of pollen which is placed on the insect's feet is lost, and hence not available to the next visitor.

In the accompanying illustration (Fig. 7) is shown a flower with two legs, belonging to a recent visitor, still sticking to the petals. It may easily be seen that the former owner of these legs would probably be of little further benefit to milkweeds. Just above the flower is pictured a fly with the third leg on the left side gummed fast to the left wing, so that it is impossible for it to fly, thus effectually preventing it from fertilizing other flowers. From these two instances, the disadvantages accruing from this over-specialization are self-evident.

In the other picture (Fig. 8), two sprays of the plant are shown natural size, so that it is more easily recognized than in the photograph of a single flower greatly enlarged. The spray on the left shows the beautiful flowers, while that on the left is a head of buds. The stem is tall and stout, and fre-

A PLANT THAT HAS OVERREACHED ITSELF

This milkweed developed a sticky juice, presumably to keep insects from getting into and out of its flowers too quickly, and to ensure that they would get well covered with pollen before they left. The device works rather too well for the good of the species. Two legs left by a recent visitor can be seen in the flower; it is probable that that particular visitor will not cross-pollinate any more milkweed blossoms, therefore all the pollen which he carried away is wasted. Above is a fly which, in visiting the flower, became so gummed up as to be unable to get away, a foot being stuck to a wing. Copyrighted photomicrograph by A. G. Eldredge, University of Illinois. (Fig. 7.)

THE COMMON MILKWEED

Although this plant, as shown in Fig. 7, is playing a dangerous game in its attempts to secure cross-pollination, it seems to be succeeding so far, for it is one of the most widespread weeds in the United States. Photograph by Dr. R. W. Shufeldt in *American Forestry Magazine.* (Fig. 8.)

quently covered with very fine hair, which may be visible only with the aid of a hand lens. The leaves are large, broad, short-petioled, and pubescent on the under side. The flowers, as has been mentioned, are quite complex in structure. This plant crosses freely with other Asclepiadaceae, producing hybrids which often present interesting features for study.

Galton, a Child Prodigy

Francis Galton, the founder of eugenics, was one of the most precocious children on record, according to Lewis M. Terman of Stanford University. Professor Terman has been studying the documents presented in Karl Pearson's admirable Life of Galton, and publishes his conclusions in the April issue of the *American Journal of Psychology*.

Between the ages of three and eight years Galton's mental achievement was at least twice that of the normal child, he thinks: that is, Galton at the age of five was as far advanced as the ordinary child of ten. At the age of four, he believes Galton had a 9-year-old intellect. This record is unequaled by any other that is as well substantiated, Professor Terman declares. In his own examinations of several thousand school children in the United States and Canada, he has never found one who was thus 100% ahead of his age, nor even 75% advanced; and the number who are 50% advanced is so small that it can be reckoned on the fingers of one hand.

Improved Wheat Produced by Ohio Station

By methods of selection improved strains of wheat have been developed at the Ohio Agricultural Experiment Station that surpass standard varieties by more than two bushels to the acre. Four million bushels more wheat might be raised in Ohio if all farmers were to sow such seed.

Many selections are discarded in these comparative tests made at the Experiment Station because they cannot withstand severe winters. Others have weak straw and are taken out of the competition on this account. A few make poor flour and bread even though they yield well. All the selections must yield more than the old standard varieties from which they were chosen, if they are to be long continued as promising new strains.

Few Women Medical College Graduates Marry

As women who follow scientific careers are on the average of superior intellectuality, their marriage rate is a matter of interest to eugenists. A study of the John Hopkins University medical graduates shows that in the years 1897–1907 inclusive, sixty women received the degree of M.D. Three of these have since died. Of the fifty-seven living, twenty-one have married and thirty-six are still single, although ten years after graduation they have reached an age when they are not likely to marry. The marriage rate of these women may, therefore, be taken at 36.8%. This is a lower rate than any general women's college shows, but perhaps no lower than the women who take the degree of Ph.D. in colleges would show. The failure of so many of the women doctors to marry is, doubtless, largely due to the fact that they are by nature inclined toward a career rather than to matrimony; and in part to a prejudice which many men have against a woman "who knows too much."

ELIMINATING FEEBLEMINDEDNESS

Ten Per Cent of American Population Probably Carriers of Mental Defect—If Only Those Who Are Actually Feebleminded Are Dealt with, It Will Require More Than 8,000 Years to Eliminate the Defect—New Method of Procedure Needed

R. C. Punnett

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IN AN article on "Hidden Feeblemindedness," which appeared in the JOURNAL OF HEREDITY for May, 1917, Dr. E. M. East raises a point of great practical importance for students of eugenics. Briefly, it amounts to this: if we know the proportion of individuals exhibiting a simple recessive character in a given population, can we decide what proportion of the dominants is heterozygous? Under certain conditions, the required answer can be readily and easily obtained. Some years ago, G. H. Hardy[1] showed that a mixed population containing p homozygous dominants, r recessives, and $2q$ heterozygous dominants was in stable equilibrium when the equation $pr=q^2$ was satisfied. It was assumed that there was random mating and equal fertility among the different classes. Hardy further showed that if the condition of equilibrium were upset through some disturbing agency the population would rapidly fall into a new position of equilibrium which would be maintained in the absence of any fresh disturbance. If we know that one of the two classes of homozygotes is less numerous than the other we can simplify the equation by considering the less numerous class as unity. Let us suppose that the recessives are less numerous than the homozygous dominants so that $p=xr$ where x is some number greater than one. Then if $r=1$, the equation $pr=q^2$ becomes $x=q^2$, and for an population in equilibrium the number of heterozygotes $(2q)=2\sqrt{x}$. The total population thus consists of the three classes: homozygous dominants, heterozygotes, and recessives in the relative proportions $x:2\sqrt{x}:1$. Now if we know the percentage of recessives in the total population, we can easily calculate the relative numbers of the three classes. For instance, in the case at issue, Dr. East states that the proportion of feebleminded in the population of the United States is 3 per 1,000, or 1 in 333. Here therefore:

$$
\begin{aligned}
x+2\sqrt{x}+1 &= 333\\
\therefore\quad (\sqrt{x}+1)^2 &= 333\\
\therefore\quad \sqrt{x}+1 &= \sqrt{333}\\
\therefore\quad \sqrt{x} &= 17.25\\
\therefore\quad 2\sqrt{x} &= 34.5
\end{aligned}
$$

In other words, the proportion of heterozygotes in such a population is rather more than 10%. The proportion is somewhat higher than the 7% arrived at by Dr. East, though we must remember that he considers his result to understate rather than to overstate the facts.

In making the above estimation of the proportion of heterozygotes, certain assumptions have been made. Like conditions must hold with regard to the birth rate and death rate of the different classes, the distribution of the factors must be similar in both sexes, and there must be no selective mating. Further, the population at any given moment must be supposed to be in equilibrium or very nearly so. In the paper cited above, Hardy showed that if a state of equilibrium were upset by some disturbing agent, a new state of equilibrium

[1] *Science*, July, 1908.

would be immediately established, and would persist as such after a further generation provided that no fresh disturbance arose. If the disturbing cause were small, the new position would be so close to the old that, for practical purposes, the population might be regarded over a few generations as unchanged.

The seemingly large proportion of heterozygotes entailed in a stable population by even a small proportion of recessives helps us to understand a feature of certain collections of human pedigrees which at one time appeared puzzling. Albinism, for example, behaves on the whole as a recessive. Nevertheless, albinos appear among the offspring in an appreciable proportion of matings where either one or both parents are normal, and where no consanguinity can be detected. The same is true of feeblemindedness. This becomes less difficult to understand when we realize that the heterozygotes are bound greatly to outnumber the recessives whenever these form a small proportion of a stable population.

There is a further point which merits brief consideration. At what rate can we hope to free a population of an undesirable recessive character by isolating, or by otherwise sterilizing those individuals which exhibit the character? In a recently published book[2] I have been able through the kindness of Mr. Norton, of Trinity College, Cambridge, to give a table showing the rate at which the constitution of a population changes when either the dominants or the recessives are subjected to selective elimination of known value. In this table, however, the most intense form of selection dealt with is the elimination of 50%, at each generation, of the dominants or recessives. Though it is unlikely that legislative measures, unless very stringent, would succeed in getting rid of a higher proportion of feebleminded without their leaving offspring, it may yet be of interest to enquire how rapid the rate of elimination would be if all feebleminded were henceforth eliminated completely, from the breeding stock of the population. I am indebted to my friend G. H. Hardy for kindly working out for me the brief table appended. Assuming that all recessives are eliminated, their proportion in the population passes

From 1 in 100 to 1 in 1,000 in 22 generations.
From 1 in 1,000 to 1 in 10,000 in 68 generations.
From 1 in 10,000 to 1 in 100,000 in 216 generations.
From 1 in 100,000 to 1 in 1,000,000 in 684 generations.

If therefore the proportion of feebleminded in the United States is 3 per 1,000 today it would require something over 250 generations, or about 8,000 years, before the proportion was reduced to 1 in 100,000, and nearly four times this length of time before the feebleminded were as few as 1 in a million. The prospect of the success of the segregation method is not hopeful. Though it may be sure it is very, very slow. For the rarer the recessive becomes the more frequently, relatively, is it produced through the mating of two heterozygotes. Clearly if that most desirable goal of a world rid of the feebleminded is to be reached in a reasonable time some method other than that of the elimination of the feebleminded themselves must eventually be found. The great strength of this defect in the population lies in its heterozygotic reserves; if the campaign against it is to meet with success it is at these that it must be directed. This is so clearly perceived by Dr. East that we cannot do better in concluding than by quoting the closing sentences of his paper.

"We have assumed that a normal mentality is completely dominant over a defective one. Is this true? Complete dominance is rare among those characters commonly studied by animal and plant geneticists. Is it not likely that the Binet-Simon or other proper tests would show that carriers of mental defects exhibit a lower mentality than pure normals? Would it not be wise to start some investigations along this line?"

[2] *Mimicry in Butterflies*, Cambridge, 1915, pp. 154–156.

CLOVEN HOOF OF PERCHERON

This photograph shows two hoofs on the front leg of a pure bred Percheron colt born and raised at the Delchester Farms, Edgemont, Pa. The sire of this colt was Imp. Kaneton 98952 (97439) and the dam was Lalouve 98981(99154). So far as I am aware, there is no abnormality of the sort in the ancestry. Although there have been several cases of cloven-hoof or polydactylism in horses, this meristic variation is rare. The ancestors of the horse had as many as five toes, but this case is not to be looked on as a case of reversion, as is the appearance of an extra toe in the guinea-pig at the present day. It is rather a type of polydactylism like that in man, where a single finger splits to produce two. This same type of polydactylism by splitting of a single digit is even more familiar in the house cat. In all animals, polydactylism has proved to be inherited in some degree, but in an irregular way. I do not know of any evidence to show how it behaves in the horse. Photograph by C. W. McDonald. (Fig. 9.)

B. O. Severson, State College, Pa.

A New Ancestor for the Goat

It has generally been supposed that all domesticated goats are descendants of the Pasang or Grecian Ibex (see the Journal of Heredity, Vol. vi, pp. 519-525, November, 1915), but Professor Adametz declares this idea is no longer tenable. He has been examining the remains of a new species of goat found in Galicia, to which he has given the name of *Capra prisca*, and thinks that this extinct species is the ancestor of most of the modern breeds. It is quite different from the Pasang. His findings are published in the *Mitteilungen der landwirtschaftliches Lehrkanzeln der K. K. Hochschule für Bodenkultur in Wien*, Vol. iii, pp. 1–21, Vienna, 1915.

English Plans to Increase the Birth Rate

That the English birth rate has steadily declined during the last generation, and that the decline has been greatest in the most valuable part of the population, are conclusions of the National Council of Public Morals, which has published its extensive investigation in a substantial volume (*The Declining Birth Rate*. London, 1916). A supplementary report outlines a number of measures which it is believed might help to secure a more adequate birth rate, in quality as well as quantity.

1. Minimum wage for workers.
2. Bonuses for all children who reach the age of fourteen, in families where the income is less than $500 or $600 a year.
3. Taxation of income of husband and wife separately, with a substantial exemption for each child, in the case of all incomes under $3,000 or $3,500 a year.
4. More free higher education.
5. Better housing facilities.
6. Development of means of national subsistence—more intensified agriculture, changes in land tenure, etc.
7. A campaign to educate public opinion to the need for more good children.
8. Simpler living, which would tend to make childbirth less painful for women; and education of women to the fact that with modern surgical technique childbirth is by no means an intolerable ordeal.
9. Public discussion of methods for increasing the birth rate.
10. Teaching fathers to bear a larger part of the burden of parenthood, instead of leaving the mother to take all the responsibility for the children.
11. Awakening teachers of religion and morals to the fact that they are remiss if they do not include eugenics in their teaching.
12. Reduction of infant mortality.

SOMATIC MUTATIONS IN SUNFLOWERS

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WE USUALLY think that, after fertilization has taken place, the characters of the resulting individual are determined, except so far as they may be modified by environmental influences. There are, however, many facts which show that, while this is generally true, it is by no means an invariable rule. Some of the apparent exceptions are evidently misleading, as when in a bird the loss or disease of the sexual organs results in the appearance of characters belonging to the opposite sex. Such cases are to be classed among those due to the environment, and have nothing to do with any fundamental change in the nature of the inherited qualities. It is quite otherwise with bud-sports in plants, which are capable, apparently, of modifying the offspring of the seeds produced by the affected branch. In all such cases it appears that a change in the hereditary constitution of the cells has occurred in the soma or body, without having any connection with the processes of sexual reproduction. Such changes also appear to be the cause of gynandromorphs in insects; those strange individuals showing the characters of the male in one part of the body, of the female in another. Thus I possess a bee of a species in which the clypeus or facial plate is yellow in the male, black in the female. In this specimen it is yellow on one side, black on the other, the dividing line running exactly down the middle. To such changes, also, we may probably attribute the disease known as cancer, in which certain cells of the body entirely abandon their normal functions. Mouse cancer can be transplanted from mouse to mouse, just as a branch of a tree arising from a bud variation may be grafted on to another tree.

Professors Babcock and Lloyd, in Journal of Heredity, February, 1917, pp. 82–89, have discussed these matters at some length, and object to the expression "somatic segregation" as going beyond the present state of our knowledge. The changes observed could be due either to some modification in a particular cell, due to causes not ascertained; or they could result from inequalities or errors in the process of mitosis or cell-division. Are we at liberty to assume that the latter explanation is correct? It is doubtless better to use a term such as "somatic mutation," which does not commit us to anything more than the fact of the change. At the same time, it must be significant that these phenomena more commonly occur, as East has pointed out, in plants known to be heterozygous. Granting that mitotic errors are extremely rare, if they occur once in many millions of divisions all the observed facts may be accounted for. It is also significant that these variations so often represent the apparent loss of one of the known determiners of the plant. This might, indeed, be due to a mutation of the determiner itself, but it is easier to believe that in a heterozygous cell one of the pair of diverse allelomorphs disappeared, and that this disappearance was due to a mitotic error.

The red sunflower (varieties of *Helianthus annuus*) is unusually favorable material for the observation of somatic mutation. I figure two remarkable heads produced in Boulder by my wife in 1917. In each case the dark rays are deep chestnut red, more or less tipped with yellow, while the pale rays are yellow. In one it will be seen that three rays are yellow, the rest red. In the other it is about half and half. The latter head is remarkable in several ways. The yellow rays are weakly suffused with red, showing that they do not wholly lack the factor for redness. Either they possess an inhibitor or they lack a factor for full color. It will also be noted that on one side the dividing line between the red and

A BEAUTIFUL EXAMPLE OF SOMATIC MUTATION

Normally this sunflower is solid chestnut red. Some change has apparently taken place in the constitution of part of the cells which formed this flower, with the result that the red has been replaced by yellow in three rays. (Fig. 10.)

the yellow runs down the middle of a ray. On the other side, the first red ray has a little pure yellow on one side of the tip.

Last year I found a head with the rays orange, except that three were red, and on each side of the three was a ray exactly half red and half yellow, the red side, of course, toward its red neighbor. Other heads on the same plant, though not all, showed more or less of the same character. Another plant in 1916 had three heads in which about half (one side) of the rays were quite strongly red, the other half with little red. The three heads were not quite alike, one having over half the rays strongly red. Another remarkable

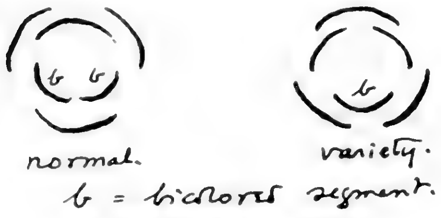
WHAT IS THE EXPLANATION OF THIS CHANGE?

Instead of a solid red, this sunflower is nearly half yellow. In one case the dividing line between the two colors runs down the middle of a ray. The yellow color is not very clear, but is suffused with red. Generally mutations are supposed to occur only in germ-cells, and strong objections have been made by some writers to assuming that they take place in body-cells. But cases like this sunflower seem to be more easily explained by the latter hypothesis than by any other. (Fig. 11.)

case was of a different sort. In a sunflower with fine dark red rays were three heads, each lacking altogether about two rays, leaving a space. The outer disc florets were also lacking at the same place. The three heads were on quite different long branches, extending from three different sides of the stem. Here the mutation apparently had lethal results.

My colleague, Dr. Geo. Norlin, who specializes in dahlias, showed me last year a singular variety called cockatoo. The flowers are lemon yellow, but some heads have the flowers white, faintly pinkish, the rays lemon at base. Dr. Norlin tells me that this production of diverse heads on the same plant is a regular character of this variety. This is suggestive of chemical instability,

and may not be a case parallel to those described in sunflowers.[1]



A CHANGED GLADIOLUS

Diagram of the flower with segments reversed, described in footnote to the text. This reversal of orientation did not affect the shape of the flower nor a change in the relative location of the dark marking. It is evident, therefore, that these things are due to independent factors. (Fig. 12.)

It is natural to recall the brilliant researches of Bridges, showing that irregularities in chromosome distribution produce the most far-reaching results. Thus in *Drosophila* the individual with one X-chromosome is a male, with two a female, but that with three is not viable. In the fertilization of plants it seems that a quantitative difference decides what shall be embryo and what endosperm. Can such differences arise in somatic mitosis? My colleague, Dr. R. C. Whitman, assures me that the cancer irregularities in mitosis, resulting in inequalities in the distribution of chromatin, have actually been observed.[2]

I take this opportunity to state that the title of my paper in the JOURNAL OF HEREDITY, August, 1917, should have been simply "Sunflower Seedlings." The first three words, which are not applicable, were added after the proof left my hands.

Decline of Germany's Birth Rate During the War

In German cities, it is stated, the birth rate for 1916 was nearly 40% lower than that for 1914. Infant mortality was higher than usual. Similar conditions probably prevail in most belligerent countries, although in England the infant mortality decreased during the first two years of the war. It seems likely that the infant mortality would be highest among the poor and ignorant, but it is conceivable that the decline of the birth rate may be greatest among the most highly educated and carefully nurtured women. If so, it will be a serious dysgenic effect of the war.

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[1] Another case, evidently belonging to a different category, is that of a pink-flowered gladiolus now before me. The lateral inferior segments of the perianth are smaller than the others and are strongly bicolored, the base deep purplish-rose, the apical part (except the pale pink margin) clear pale yellow. On one spike, while the upper flowers are normal, as just described, the lower ones have only one of these modified segments, which is central. It overlaps the two large lower ones, which are like the upper; whereas in the normal flower the large median lower segment is overlapped by the bicolored ones. In this case there has occurred a reversal of the orientation of the perianth segments, so that instead of having two outer above and one below, and one inner above and two below, there are two outer below and one above, and two inner above and one below. This has not affected the general shape of the flower, nor has it caused a reversal of the orientation of the dark marking, affording a curious illustration of the independence of the three factors.

[2] I have recently found a garden *Canna*, with flowers normally bright yellow, the petals profusely spotted with bright red, in which one flower on a spike was abnormally colored. In this flower two of the petals were entirely brilliant red, while a third had exactly one-half red, and the other half yellow with the elongate red spots. The dividing line is exactly in the middle, and is absolute. This is quite similar to the bicolored sunflower ray, and it is especially interesting as showing in a single petal the two types of bicoloration: one (the spotting) due to a pattern factor, normal to the plant; the other one to cell mutation or somatic segregation. On the segregation hypothesis we should apparently be compelled to suppose that the full red type was recessive to the spotted. Does any reader know whether this is the case in Cannas?

It is also to be remarked that the somatic mutation or segregation evidently took place at an early stage in flower formation, and both the canna and the sunflower indicate that the foundation of any single petaloid element is bicellular. The canna petal must have been derived from contributions from two already different types of cells, one destined to produce the red, the other the spotting. The exactly equal contributions indicate an early bicellular condition, not the fusion of two multicellular groups.

ORIGIN OF THE STRIPED CANE

A. D. SHAMEL, *Riverside, Cal.*

ARUNDO DONAX, Linn. is a tall, reed-like grass with broad, flat leaves, and large plume-like flowers. It is sometimes called the giant reed, and is often erroneously mistaken for the bamboo to which it is only distantly related. In England the stems are said to attain a height of 8 or 10 feet, but in southern California they frequently grow 18 or 20 feet high. The stems are sometimes used in making the reeds of the oboe, bagpipes and some other musical instruments. It is said[1] to be probable that *Arundo Donax* is one of the plants alluded to in the Scriptures as the Reed. The canes are long, straight and light, making excellent fishing poles and arrows. The latter quality was of great importance to the warlike Jews after they began to practise archery with effect. The heroes of Homer made their arrows of this reed (*Iliad xi*), and the tent of Achilles was thatched with its leaves. The canes were also used in making a great variety of useful articles including looms, baskets, and fish traps, according to some of the older herbals. At an early date in history this reed was widely grown over the south of Europe, Egypt and other nearby regions.

In southern California *A. Donax* is occasionally found in the gardens and grounds of some of the homes but more commonly a striped variety, *A. Donax* var. *variegata* is used for ornamental planting. At the foot of Victoria hill, near the writer's home, there is a fine clump of the variegated *Arundo Donax*. Only one or two plants were originally set out, about 1902, but in a dozen years the plants had spread until they occupied a space of about 200 square feet. The boys in Riverside secure many of their favorite fishing poles from selected canes of these plants. The canes are also very popular with gardeners who use them for staking beans and other climbing plants. Neighbors obtain many rootstocks from this group for ornamental planting. In 1914 all but a very few of the plants were transplanted to other locations, but at the present time, three years later, the group has been partly regrown from the few rootstocks left in the ground.

The canes of this variety are small, usually not more than about one-half inch in diameter, are comparatively uniform in thickness from base to tip, and frequently attain a length of from 12 to 15 feet. The leaves are numerous, cordate-clasping and hairy at the base, about 2 inches wide and from 15 inches to 2 feet in length. The leaves are striped, usually alternately green and white, giving the groups of plants a striking and beautiful appearance.

On a recent examination of the Victoria hill group of variegated plants, the writer noticed that some of the canes possessed leaves that were not variegated. On further study some variegated canes were found to have one or more sections bearing green leaves as shown in Fig. 13. In some cases green and variegated canes grow from different buds on the same rootstock.

Observation of variegated plants in this and other locations reveals the fact that the amount of white color, *i. e.*, the width and arrangement of the white stripes in comparison with the green stripes, varies greatly in different plants and sometimes on the same plant. Some plants have leaves in which the white stripes are several times as broad as the green ones, while in others the reverse condition prevails.

Inquiry has brought out the fact that several strains of the variegated canes have been isolated through the selection of offshoots. In other words the strains have originated as bud variations and have been propagated through bud selection.

The variegated bud sports probably must have occurred in *A. Donax* for hundreds of years. In Green's and other old herbals mention is made of the variegated or striped varieties.

[1] Treasury of Botany, p. 98.

AN ORNAMENTAL BUD-VARIATION.

Part of *Arundo Donax* plant showing both striped and green leaves. At the base of this particular reed, which was 12 feet in length, the leaves were striped as was the case at the top. In this group of reeds some of the individual reeds have wholly striped leaves and others wholly green leaves. (Fig. 13.)

The variegated canes are usually not so tall nor their leaves so large as those of the green plants in this locality. During the heavy frosts of January, 1913, the tender growth of the variegated plants was more severely injured than that of the green ones; the green plants therefore seem to be somewhat more hardy than those of the variegated variety.

This case is presented for the purpose of calling attention to the origin of a valuable variety of plants through bud variation and its isolation through bud selection.

COLOR INHERITANCE IN MAMMALS

IV. The Rabbit—Has Three Sets of Multiple Allelomorphs Which, as in Six Other Cases in Mammals, Determine Linear Series of Physiological Effects Not to be Explained as Mere Linkage of Factors in the Germ-cells

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RABBITS are very rich in color varieties and more unit differences from the wild gray have been thoroughly demonstrated than in any other mammal. The ten known unit differences listed in the box below fall into seven independent sets of allelomorphs. In three cases triple allelomorphs have been proved. Most of the possible combinations of these factors have been made but partial coupling does not seem to have been thoroughly investigated.

The two white patterns—English and Dutch—make an interesting comparison. Hurst[1] showed that the Dutch pattern is due to a unit factor which is nearly recessive. Heterozygotes generally show a small amount of white. There are all variations in the pattern from a very little white to black-eyed white, but the mode of inheritance of these differences has not yet been solved. Hurst[2] found the English pattern to be dominant on the whole, although the heterozygote shows distinctly more color than the homozygous English. These results have been confirmed by all later work.

Wild Gray Rabbit—w S I C A E B (Pattern of black and yellow)

$1a_1$	W,w	W—English pattern
$1a_2$	S,s	s—Dutch pattern
$1a_3$	I,i	d—dilute gray (blue and cream)
1b	C, C_h, C_a	C_h—Himalayan, C_a—albino
$2a_1$	A, A_t, A_b	A_t—black and tan, A_b—black
$2a_2$	—	
$2a_3$	E_d, E, E_y	E_d—black, E_y—yellow
2b	B,b	b—brown agouti (brown and yellow)

Classification explained in paper on the mouse, JOURNAL OF HEREDITY, 8:373, August, 1917.

The fundamentally different biochemical nature of the two patterns was shown by Onslow as discussed in the first paper of this series. He found an enzyme inhibitor in the skins of English rabbits but merely an absence of the enzyme, tyrosinase, in Dutch rabbits. There is considerable difference in appearance. As in other piebald mammals, the Dutch rabbit has large colored areas with solid boundaries sharply separated from the white parts. In the English pattern, there is a greater breaking up of the spots and at the borders white and colored hairs are intermingled. This pattern holds a somewhat isolated position at present. It can hardly be compared with the so-called dominant white of mice which seems to belong to the piebald class. It is perhaps most closely allied with the dominant whites among the larger animals as in the white of Shorthorn cattle or of sheep. In these, however, there is a tendency toward a uniform roan in the heterozygotes. On this basis, the English factor is put in class $1a_1$, while the Dutch factor is put in class $1a_2$.

The maltese type of dilution is familiar in rabbits and was found by Castle[3] to be a Mendelian recessive. This factor reduces yellow to cream as well as black to blue. It resembles closely

[1] Hurst, C. C. 1905. *Linn. Soc. Jour. Zool.*, 29:283–324.
[2] Hurst, C. C. 1906. *R. Hort. Soc. London*, p. 114.
[3] Castle, W. E., Walter, H. E., Mullenix, R. C. and Cobb, S. 1909. *Carn. Inst. Wash. Pub. No.* 114. 68 pp.

the dilution of mice and may well be put in the same class.

ALBINO SERIES OF ALLELOMORPHS

The Himalayan rabbits resemble albinos except that they show a brownish-black color at the points. They never show yellow under any conditions. Perfect albinos are also well known in rabbits and Castle[4] found that each of these types segregated from crosses with fully colored rabbits without producing the other and, in crosses with each other, also followed unit Mendelian inheritance. He concluded that the Himalayans contain a modification of the color factor. The series of three variations agrees well with the series of four in guinea-pigs and of three in rats. It is interesting to note, however, that the lowest known albino allelomorph in guinea-pigs seems to correspond rather with the Himalayan than with the perfect albino in rabbits.

AGOUTI SERIES OF ALLELOMORPHS

As in other rodents, black was early found to be a simple recessive to gray.[5] An intermediate condition is known in the black-and-tans in which the back is black with only a few ticked hairs while the belly is white and yellow. This was shown by Castle and Fish[6] to be due to an intermediate variation of the same factor by which grays differ from blacks. This series of three allelomorphs is naturally to be compared with Cuénot's series of four in mice: yellow, light-bellied gray, gray-bellied gray and black. The sequence of effects seems different but such a difference may well be due to independent causes. It may be pointed out that in a stock of mice with a higher density of black than usual (due to factors of class $2a_3$) the sequence of effects produced by the four agouti allelomorphs approaches that in rabbits.

DENSITY SERIES OF ALLELOMORPHS

The series of three allelomorphs for density of black or brown (E_d, E and E_y) is a very interesting one. Castle[7] demonstrated that sooty yellow (black belly and tail) and clear yellow (white belly and tail) differ from black and gray rabbits respectively by the same recessive Mendelian factor. He called the contrasted characters extension and restriction of black. Punnett[8] discovered a new dominant factor in the presence of which rabbits which would otherwise be gray were black. This factor, of course, produced no visible effect in animals which were already black. He called this the density factor. He found it to be inherited independently of the agouti series but completely coupled with the extension factor E. The numerical results of complete coupling are identical with those of multiple allelomorphs. The two terms are useful only in theory. Factors which are partially coupled have no necessary physiological relationship as has been abundantly shown in Morgan's work on Drosophila. But the numerous cases of multiple allelomorphs or complete coupling in mammals apparently all involve physiological relationship.[9] The factors when arranged in the order of dominance determine a linear series of physiological effects. Again, even partial coupling seems to be relatively uncommon in mammals owing presumably to the large number of chromosomes. But at least nine series of multiple allelomorphs are known among them. The main effects of Punnett's density factor fit admirably into the extension, or perhaps better, density series in rabbits. With

[4] Castle, W. E. 1905. *Carn. Inst. Wash. Pub. No. 23*, 78 pp, and Castle and associates, 1909, *ibid.*

[5] Hurst, C. C. 1905. *Loc. cit.*

[6] Castle, W. E. and Fish, H. D. 1915. *Amer. Nat.*, 49:88–96.

[7] Castle, W. E. and associates. 1909. *Loc. cit.*

[8] Punnett, R. C. 1912. *Jour. Gen.*, 2:21; 1915, *Jour. Gen.*, 5:37–50.

[9] This distinction between complete coupling and multiple allelomorphs was pointed out clearly by Sturtevant in connection with albino series in rabbits, 1913. *Amer. Nat.*, 47:234–238. In the case of the density series discussed here, interpretation as a series of multiple allelomorphs or "polygamous factors" instead of by complete coupling was suggested by Wilson, 1912, 1913, *Sci. Proc. R. Dub. Soc.*

formula $E_yE_yA_bA_b$ there is only feeble development of black and the appearance is sooty yellow. In the presence of the agouti inhibitor E_yE_yAA even this feeble black entirely disappears and the rabbit is clear yellow. On raising the level of production of black by replacing E_y by E, the sooty yellow becomes black (EEA_bA_b) and the clear yellow becomes gray (EEAA), the agouti factor now inhibiting black only in part. On further raising the level to E_d (or ED in Punnett's nomenclature) the black can become no blacker ($E_dE_dA_bA_b$) but the inhibitor in gray rabbits is entirely neutralized and formula E_dE_dAA gives black. This factor is not entirely dominant as heterozygotes may show a few agouti hairs on the nape of the neck giving a color which Punnett calls agouti-black. Among these heterozygotes, Punnett found a difference which seemed to him to eliminate the hypothesis of multiple allelomorphs. According to him EDEd (E_dE on the hypotheses of triple allelomorphs) is agouti black but EDE_yd (or E_dE_y) is black. It is, indeed, surprising to find the yellow factor E_y determining a greater tendency toward black than its allelomorph E. But the anomaly appears equally great to the writer in both theories and so cannot be used as an argument. Further, the figures so far presented do not seem altogether demonstrative on this point. For a critical test it would be necessary to obtain the two heterozygotes (E_dE and E_dE_y) from the same litter and prove a difference in appearance. It may be that either formula may be black or agouti-black depending on subsidiary factors and a comparison of them when derived from different crosses may lead to erroneous results.

CHOCOLATE RABBITS

Punnett also reported on a variation which replaced black by brown in all combinations and is apparently comparable with the brown variations of other rodents. He noted an increase in the amount of yellow in agouti-browns (AAE_dEbb) as compared with agouti-blacks (AAE_dEBB). This is in harmony with conditions in other cases. As in pink-eyed agouti guinea-pigs, the weakening of black by a factor of class 2b permits an extension of yellow although not in so direct a way as reduction of level in a factor of a class $2a_3$ such as in the series E_d, E, E_y just discussed.

The Supposed Law of Compensation

Ralph Waldo Emerson made famous the law of compensation, according to which, Nature always compensates those who are in any way handicapped, and vice versa. Those who have great ability in abstract thinking, it is supposed, will be inferior in ability at concrete problems; those who are slow to learn will be long to remember; those who are weak in arithmetic will be good in history, and those who have beauty will lack brains. The exact methods of modern psychology have so uniformly shown this so-called law to be baseless, that it has long been discredited, and every student knows that, in general, the reverse holds true: that correlation, not compensation, is the law of nature. The man who is quickest to learn will in most cases have the best memory; the man who excels in arithmetic is likely to be above the average in historical erudition; and the best-looking people usually have more than ordinary intelligence. In many years of research, almost no cases have been found which bear out Emerson's generalization; hence it is something of a surprise to find several such cases reported by W. A. McCall of Teachers' College (*School and Society*, 1917, pp. 24-30). He states emphatically, however, that the cases which he reports are exceptional, and do not shake the general rule that superiority in one thing involves superiority in other things. "To him that hath shall be given" is certainly the general law of man's nature.

COLOR INHERITANCE IN MAMMALS

V. The Guinea-pig—Great Diversity in Coat-pattern, Due to Interaction of Many Factors in Development—Some Factors Hereditary, Others of the Nature of Accidents in Development

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THE four series of which dilution (C_d), black (A_b), yellow (E_y) and brown (b) are the recessives have been shown to be inherited independently of each other by Castle[1] who crossed wild *Cavia cutleri* of Peru (CAEB) with a brown-eyed yellow race of the tame guinea-pig, *C. porcellus*, known not to transmit agouti ($C_dA_bE_yb$). He obtained all of the visibly distinct combinations in F_2 in proportions very close to those expected. The pink eye factor (p) is known not to be an allelomorph of any of the others but thorough tests have not yet been made for linkage. White spotting can be combined with any color and so is no doubt inherited independently.

AGOUTI-COLORED CAVIES

Cavia cutleri Bennett—SCAEBP. *Cavia porcellus* Linn—SCAEBP. *Cavia rufescens* Lund—SCA_rEBP (*Patterns of black and red or yellow*)

$1a_1$	—	
$1a_2$	S,s	s—piebald
$1a_3$	—	
1b	C, C_d, C_r, C_a	C_d—dilute (sepia and yellow), C_r—red-eyed dilute (sepia and white), C_a—albino
$2a_1$	A, A_r, A_b	A_r—ticked-bellied agouti, A_b—black
$2a_2$	E, E_p, E_y	E_p—tortoise, E_y—yellow
$2a_3$	—	
2b	B,b	b—brown-eyed brown agouti (brown and red)
	P,p	p—pink eyed agouti (pale brown and red)

Classification explained in paper on the mouse, JOURNAL OF HEREDITY, 8:373, August, 1917.

No dominant white is known in guinea-pigs. A type of roan or silvering is common but does not follow simple Mendelian inheritance. A cross between a good roan and self produces young which are usually slightly silvered on the belly. Those in F_2 are also generally slightly silvered and there is no clear-cut segregation. In these silvered guinea-pigs there is not merely an intermingling of colored and white hairs but also an intermediate condition within many hairs. Thus black, dull black, and white hairs (or red, whitish red and white) are found side by side.

THE PIEBALD PATTERN

Some grade of piebald between mere traces of white to the black-eyed white condition is almost universal among tame guinea-pigs. The pattern is exceedingly irregular and generally asymmetrical. The writer has found it exceedingly variable even within single litters after sixteen generations of the closest inbreeding and there can be no question that a very large part of the variability is not represented in the germ-plasm. This is further demonstrated by the low correlations (.15 to .30) between parent and offspring or between brothers in stock bred at random as regards pattern. The average quantity of white, nevertheless, seems to be much more strongly inherited than the pattern in which it is disposed. The latter is inherited to some extent, however, as MacCurdy and Castle[2] were able by selection to

[1] Castle, W. E. 1916. *Carn. Inst. Wash. Pub.*, No. 241, part 1, 55 pp.
[2] MacCurdy, H. and Castle, W. E. 1907. *Carn. Inst. Wash. Pub.*, No. 70, 50 pp.

increase the extent to which a certain relatively uncommon pattern, the colored nose spot, was produced. A similar differentiation in regard to pattern has taken place automatically among several families of very closely inbred stocks which the writer is studying. The very large amount of variation in both amount and pattern make Mendelian analysis difficult and no unit differences have been thoroughly demonstrated. The writer has, however, obtained rather clear indications of segregation of a recessive unit factor for piebald in crosses with a self-colored feral stock and with a certain inbred stock which is roan but not piebald. Other nearly self-colored inbred stocks behave very differently. That piebald is inherited independently of the roan variation is shown by a cross of a uniformly piebald stock with the roan, but not piebald, stock mentioned above. Several, at least, of the young were solid black, lacking both piebald and roan, while the others approached this condition very closely.

ALBINO SERIES OF ALLELOMORPHS

Albino guinea-pigs may show enough black sootiness in the fur to bring out clearly an underlying piebald pattern. They generally have black points and thus correspond best with Himalayan rabbits. Castle[3] found albinism clearly recessive. Later[4] he found a peculiar series of varieties in Peru which seems to be unknown to American fanciers. These had dark red eyes and white in place of yellow in the fur but a fairly intense black. An allelomorph of albinism proved to be responsible for their condition. The same variation seems to have been obtained by Blaringhem and Prévot[5] from South America and they were much puzzled by its mode of inheritance. The writer found another allelomorph in the series in the common dilute guinea-pigs in which intense yellow or red is reduced to a lighter yellow or cream and black is slightly reduced. Certain peculiar relations of dominance within the series of four allelomorphs were also found.[6] These were discussed in the first paper of this series. (JOURNAL OF HEREDITY 8:224-235, May, 1917.)

THE AGOUTI PATTERN

Castle[7] early found the agoutis to differ from the black and brown varieties lacking this pattern by a unit dominant factor. In ordinary agouti guinea-pigs the belly appears yellow while the back is black, each hair having a yellow band. The width of the yellow band is quite variable and when narrow, black may invade the base of the hair on the belly. As in other cases, such variations may be due either to variations in the agouti factor itself or to independent factors. In this case both have been demonstrated. Thus the yellow band increases greatly when black is weakened by the action of the pink eye factor. The same is true in the brindle spots usually found in tortoise-shells. Thus factors p and E_p can be looked on as modifiers of agouti. Probably all factors of class 2 and perhaps some of class 1 in a more indirect way produce variations in the width of the agouti band. This effect seems to be through weakening or reducing the amount of black to be inhibited by the agouti factor. A similar visible effect is produced by varying the strength of the inhibiting agent itself and this is presumably the mode of action of an allelomorph of the factors for guinea-pig agouti and nonagouti found by Detlefsen[8] in hybrids between the guinea-pig and *C. rufescens*, a Brazilian cavy. The writer[9] was able to confirm the existence of these three allelomorphs but could find no such difference between the

[3] Castle, W. E. and Allen, G. M. 1903. *Proc. Am. Ac. Arts and Sci.*, 38:603.
[4] Castle, W. E. 1914. *Amer. Nat.*, 48:65–73.
[5] Blaringhem and Prévot. 1912. Quoted by Lang, 1914, *Experimentelle Vererbungslehre.*
[6] Wright, S. 1915. *Amer. Nat.*, 49:140–148, 1916, *Carn. Inst. Wash. Pub.*, No. 241, part ii, 101 pp.
[7] Castle, W. E. 1905. *Carn. Inst. Wash. Pub.*, No. 23, 78 pp. 1907. *Sci. N. S.*, 25:151–153. 1913. *Carn. Inst. Wash. Pub.*, No. 179, p.1–10, etc.
[8] Detlefsen, J. 1914. *Carn. Inst. Wash. Pub.*, No. 205, 134 pp.
[9] Wright, S. 1916. *Loc. cit.*

agouti of another wild species *C. cutleri* and the guinea-pig agouti. *Cavia rufescens* itself does not differ as much from the agouti guinea-pig or *C. cutleri* as do its hybrids. It has, however, a somewhat darker appearance owing to narrow yellow bands in the hair. In the hybrids with the guinea-pig the distinction between the agouti of *C. rufescens* and that of the guinea-pig in most cases increased as the amount of guinea-pig blood was increased. In many cases the young were almost indistinguishable from blacks which is never the case with the yellow-bellied guinea-pig agoutis. This effect was especially noticeable when the guinea-pig parents were of a certain exceedingly intense black stock. The fact that all stocks of guinea-pigs with factor C show a more intense black than the pale slaty color of the wild species (which also can be shown to possess factor C) suggests that guinea-pigs have acquired through selection a much higher level of factors in class $2a_3$. Thus *C. rufescens*, with a lower level of both the agouti factor and the density of black, shows about the same net result in pattern as the guinea-pig agouti. As noted above, the Peruvian cavy, *C. cutleri*, apparently possesses the same agouti factor as guinea-pigs. It follows that the dark gray of *C. rufescens* and the light gray of *C. cutleri* differ by a unit Mendelian factor, a thing not demonstrated for many specific differences among animals. It should be added, however, that there is considerable variation within *C. rufescens* and both allelomorphs may be present as suggested by Castle.

TORTOISE SERIES OF ALLELOMORPHS

Self red or yellow differs from the colors which show black or brown in the fur (except the sooty reds) by a unit factor as shown by Castle,[10] and confirmed by later workers.[11] Castle showed that reds might be homozygous or heterozygous for the agouti factor or not transmit it at all (E_yE_yAA, $E_yE_yAA_b$ and $E_yE_yA_bA_b$) a point which differentiates the red and yellow of guinea-pigs completely from red and yellow in mice. Recently Ibsen[12] has announced that the common tortoiseshells (black and red spotted) contain an allelomorph between complete extension of dark colors and the complete restriction found in reds and yellows. While he has not yet published the evidence, his series, E, E_p and E_y, is adopted here provisionally. The writer has obtained results, in experiments made to test the hypothesis, which seem to bear it out although not yet demonstrating it exhaustively. The tortoise-shell pattern like the piebald may vary from a very small amount of red to nearly self red and it is very probable that animals with formula E_pE_p may occasionally overstep both limits. As in piebalds, asymmetry is very common and much of the variation is doubtless merely developmental. There are not only variations in the extent and localization but also in the intensity of the black spots. Areas of the fur on the same animal may be wholly intense black (or agouti, brown, etc.) or wholly red or intermediate, a brindle of black and red, in which the black is of reduced density. In some cases, instead of a brindle, the black and red become so thoroughly blended in the hairs that a brown spot results. In this way animals which are both tortoise and piebald are occasionally not merely tri-colored but four-colored with solid spots of black, brown and red on a white ground.

PIEBALD AND TORTOISE PATTERNS

There is some similarity in the patterns of piebald and tortoise guinea-pigs. The differences, however, are no less striking so that even in red-eyed dilutes (C_rC_r) in which both patterns are in white, they can often be distinguished. In piebalds the pattern is typically one of large spots or blotches of color on a white ground. There are certain more or less definite spot centers as the eyes and ears, as noted by Castle[13]

[10] Castle, W. E. 1905. *Ibid.*, 1907, *loc. cit.*
[11] See for example, Sollas, I. B. J. 1909. *Rept. Evol. Com. R. Soc. London*, 5:51–79.
[12] Ibsen, H. L. 1916. *Genetics*, 1:287–309.
[13] Castle, W. E. 1905. *Loc. cit.*

and Allen.[14] Spots on the back are usually large—seldom less than one-third the total length of the back if present at all. There is little or no symmetry about the mid-dorsal line and spots cross freely from one side to the other. Certain kinds of spots are unusual except in particular stocks in which they may be common. Such are a nose spot and a small rump spot. Spots seldom cross the mid-line of the belly but are sharply truncated by the latter, a fact which strongly suggests that the pattern is determined at a very early stage of the embryo when the two sides of the belly are as far from each other as possible. In animals which are largely colored the location of the white areas is quite characteristic. Thus white feet, white areas on the nose and mid line of the face, on the throat, narrow white streaks along the under surface of the legs and along the middle of the belly are especially common.

In tortoises the relation of red to black is more nearly coördinate than is the relation of white to color in piebalds, where, as just noted, it is distinctly a case of white gaps between colored spots. The pattern is highly irregular but a tendency may often be noted to an arrangement of the colors in relatively narrow alternate bands across the back. The mid-line of the belly breaks the continuity of the pattern on each side as sharply as in piebalds.

INTERRELATIONS

When both patterns, piebald and tortoise, are combined,[15] it becomes obvious that they are in some way related in development. The spots are, as a rule, either entirely black, entirely red or entirely a kind of brindle or brown. This, of course, would not be the case if the patterns were simply laid over one another. Again, there are certain peculiarities within the spots which prove an interrelation. Brindle spots generally show more dark color at the center and thus vary from nearly black with a brindle border to nearly red with a brindle center. Another fact which shows an interrelation of piebald and tortoise is a curious sex difference. Males, in general, show slightly more color as opposed to white and also more black (or agouti, etc.) as opposed to red than their sisters. It is not true in general, however, that increase in white means increase in ratio of red to black. In a given stock the average ratio of red to black is remarkably constant for all grades of white. In attempting to explain the relations it is also to be noted that the presence of piebald seems to affect the tortoise pattern but not the reverse. The localization of white seems to be the same whether the spots are all black, all red or some black and others red. The tortoise pattern, on the other hand, loses its tendency to narrow transverse belts and conforms itself to the shape of the colored spots. It may be added that it is easy to make sketches of piebalds and tricolors but tortoises generally have such a jumble of small spots and irregular brindling that a satisfactory sketch is difficult to make.

NO SIMPLE EXPLANATION

It is evident that no simple explanation of the determination of tortoise, piebald and tricolor patterns can be looked for. In piebalds there seems to be involved some substance essential for color production which has such a relation to the latter that above a certain critical level maximum color production can take place, below it, none whatever. Hereditary factors and, perhaps, also environmental conditions determine the general level in an animal while various causes, hereditary or otherwise, acting in development raise or lower this level in different parts of the coat, and so make possible a pattern. In tortoise there seems to be essentially the same situation with respect to something necessary for the production of black, except that the

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[14] Allen, G. M. 1914. *Amer. Nat.*, 48:385–412; 467–484; 550–566.

[15] Tricolors have been discussed by W. E. Castle, 1912, *Amer. Nat.*, 46:437–440; A. Hagedoorn, 1912, *Amer. Nat.*, 46:682; Goodale and T. H. Morgan, 1913, *Amer. Nat.*, 47:321; and H. Ibsen, 1916, *loc. cit.*

critical level is not so sharp. There is a zone between red and black in which brindle or brown may appear. The variation in both patterns from a high degree of symmetry with respect to the parts of the body to a condition of asymmetry which almost wholly disregards the latter, points to a complexity of causes. Perhaps time is a factor—pattern differentiation, which arises very early, tending to be unrelated with the later symmetrical differentiation of the embryo and vice versa. In this connection it is interesting to note that in some piebald mammals as rats, rabbits and Hereford cattle there is a high degree of symmetry, while others as mice and Holstein cattle approach closer to the chaotic patterns of guinea-pigs.

In the relations of the patterns to each other, there are all variations from independence to obvious coördination. The main genetic factors, as S and E_p, seem to be inherited independently, other factors, of which sex is one, act on both patterns, perhaps through some general influences on metabolism, and doubtless there are both independent and common nongenetic factors which act during development. Among the latter must be considered the possibility that mutations in the hereditary material received from the zygote may take place at random in the somatic cells producing spots in the groups of cells which descend from them. Differentiation due to such a cause would produce a mosaic of coördinate black, red and white spots. On the other hand, the general relations of color to white and also of black to red in the case of a dark spot with a red border surrounded by white suggest the radiation of some influence from centers in the skin, with simultaneous effects on both the level for pigment production and for black.

Summing up, it appears that coat pattern in guinea-pigs, and doubtless other animals as well, must be determined by a complex of causes of very diverse kinds. There are hereditary factors of various sorts and factors which are of the nature of accidents in development. There are factors which affect the extent of pattern and others which determine its localization. Of the latter some relate the pattern to the axis of symmetry and organs of the body while others are random in their incidence. Some factors affect only the tortoise pattern in one way or another, or only the piebald pattern, while others have a simultaneous influence on both. The result is such a diversity of pattern among tri-colors that a rough sketch will identify almost any animal in a stock of a thousand.

OTHER VARIATIONS OF GUINEA-PIGS

Black sootiness often appears in the red or yellow parts of the fur of guinea-pigs as they grow older. This sootiness is especially conspicuous in pale creams and in whites resulting from extreme dilution of red (C_rC_r). As such sootiness never appears in the white parts of piebalds, its presence gives another means of distinguishing white spots which represent reduced red from piebald white, besides the different appearance mentioned above. The mode of inheritance of black sootiness is unknown.

Two independent Mendelian factors are known which dilute black very uniformly throughout the skin, fur and eyes, but have no influence on the intensity of red. The first of these to be known[16] changes black to brown, ordinary agouti to cinnamon, black and red tortoise to brown and red tortoise, black-eyed red to brown-eyed red, etc. The other is responsible for a series of pink-eyed colored varieties unknown to the fanciers. The latter was found by Castle[17] in one of the South American stocks which also furnished the red-eyed dilution. The eye generally shows traces of pigment. Black in the skin and fur is reduced to a very pale brown, much paler than in the brown varieties while red is unaffected in intensity. Both the brown factor, b, and the pink eye factor, p, are Mendelian recessives and both obviously belong in class 2b.

[16] Castle, W. E. 1907. *Sci. N. S.*, 26:287–291; 1908, *Sci. N. S.*, 28:250–252.
[17] Castle, W. E. 1914. *Loc. cit.* 1916. *Loc. cit.*

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PLANTING NEAR MOUNT HOOD

A typical scene in the Oregon National Forest at the Still Creek Planting Station, showing the ground which has been devastated by fire and which is being planted with young seedling conifers. The rehabilitation of such areas as this means a sure and safe water supply and future timber, as well as picturesque scenery. (Frontispiece.)

CHOOSING THE BEST TREE SEEDS

The Influence of Parental Character and Environment upon the Progeny of Douglas Fir—Study Will Extend Over at Least Forty Years

CHARLES J. KRAEBEL

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THE influence of the character of the parent plant upon the development of the progeny of that plant is a matter of vital importance in plant culture. The influence of the parental habitat as reflected in the seed productivity and seed quality is likewise important, for practical and economic reasons. That both these considerations are regarded in ordinary agriculture is a matter of common knowledge; but ti is not so commonly known that the application of the principles of genetics to the culture of forest trees and to the practical management of forest lands has come to be a necessity of modern forestry.

In the Forest Service this application is required in seed collection for extensive artificial reforestation, and in the choosing of seed trees to be left in logging operations in the National Forests. In reforestation work, great quantities of forest tree seeds are used annually by the government nurseries, and this seed must be harvested within a very short time in the fall. The bulk of it is collected by the Forest Service itself, but much of it must often be purchased from commercial seedsmen. In the past there was no experience in American forestry to serve as a guide in this matter, and the gathering of the seed was therefore controlled by expediency rather than by the principles of genetics. Since large quantities were required quickly, it was natural to collect such seed as was nearest and easiest to obtain. There is good reason for believing that in America, as in Europe, there resulted from this cause occasional fundamental errors in planting, as, for example, the planting in severe sites at high altitudes of plants raised from seed collected on moderate sites at low altitudes. In Europe, particularly in Sweden, the percentage of failures in such plantations was often excessively high, and the failure frequently did not occur until the plantations had reached the age of ten or fifteen years. Guided by that experience, much good can be done in this country by the appropriate disposition of seed the source of which is definitely known. But before it is possible to specify with certainty what sort of seed is best for any particular set of conditions, it is necessary to know something of the influence of the character and environment of the parent tree upon the qualities most desired in its progeny.

EUROPEAN STUDIES

A vast amount of work has been done upon this same problem with European species by the forest experiment stations of Europe. For over twenty years the subject has received the attention of such eminent students as Mayr, Cieslar, Engler, Zederbauer and Huffel. Some work has been undertaken with Douglas fir, from seed obtained through the Forest Service, by Count von Berg, of Livonia, Russia. The work of Professor Engler of Switzerland has been especially exhaustive and productive of practical results with Austrian pine. General principles have been evolved which have been applied, in a measure, to American practice. But for any species of such extensive range and large value as Douglas fir, the only satisfactory procedure is to conduct an individual study for the species, which answers by experimental results the questions which can only be so answered.

The study here described, known as

[1] Mr. Kraebel is now with the 10th Engineers (Forest) in France, and was hence unable to read proof on his article.

GIANT DOUGLAS FIR OF CALIFORNIA

More than eight feet in diameter, the magnificent Douglas fir standing to the immediate right of the track is the type of tree with which tree growers are gradually reforesting the devastated areas. (Fig. 1.)

the Douglas Fir Seed Study, was initiated in the fall of 1912 at the Wind River Experiment Station near Carson, Washington. It will be continued for forty years, or as much longer as it will yield data of value. The data gathered during the first few years are expected to serve primarily as a guide in the collection of seed, and secondarily as an aid in the selection of seed trees to be left standing in timber-sale cuttings. Among the immediate questions to be answered are the following:

1. What class of tree produces the best quality and quantity of seed—young, middle-aged or old; healthy or diseased?
2. What particular qualities of seed are required to produce the most desirable seedlings for artificial reforestation on various sites?
3. What is the influence of locality of the parent tree upon the progeny raised from that tree?

It will be appreciated at once that there are innumerable questions, subordinate to these, which enter the problem but which cannot be discussed in the brief compass of this article.

METHODS

In the fall of 1912, cones were collected from 127 different trees in ten different localities on the west slope of the Cascade Mountains from northern Washington to midwestern Oregon. The classes of trees from which cones were gathered are as follows:

1. (a) Very young (14–30 years)
(b) 75–100 years old
(c) 100–200 years old
(d) Old (over 300 years)
} Open-grown trees at low altitudes.
2. (a) Second growth (60, 65 and 100 years)
(b) Old growth (220 and 600 years)
} Dense-grown trees at low altitudes.
3. (a) Second growth
(b) Old growth
} Trees at high altitudes.
4. (a) Young (40 years)
(b) Old (150 years)
} Trees from Steilicoom Plains } Effect of poor soil.
5. (a) Diseased
(b) Sound
} Trees of middle age (275–400 years).

The altitudes of the sites varied from 100 to 3,850 feet above sea-level. The trees ranged in age from fourteen years to 600 years, and, in size, from a diameter of 3½ inches to 6½ feet. The trees were carefully chosen for the desired qualities, and for each condition several trees were used in order to minimize the likelihood of disturbance through the possible erratic qualities of some individual tree. By this means a group of four to ten trees, rather than a single tree, became the unit of the study. The cones were taken from all parts of the crown of each tree and the proportion of those taken to the total yield of the tree was carefully noted. For each tree a detailed description was made by the collector, including such points as size, age, tree class (whether dominant or suppressed in the stand) character of crown, condition of health, etc., besides the important features of the site in which the tree grew. A sketch of the tree was also made to show the shape and proportions of the crown and the location of cones upon it. The trees were not marked for future examination, since, in the case of the older trees, the cones were gathered after the trees had been felled in the process of logging.

As the cones were received at the Experiment Station each lot was given a number, and all information concerning the seed or seedling resulting from that lot of cones has thenceforward been recorded under this number. By this means the chance of personal prejudice toward one conclusion or another in making observations is eliminated, for the observer knows nothing of the source of the stock he is examining. From the time of their arrival at the Experiment Station, the cones and seeds, and the seedlings raised from them, have had identical treatment. In a number of

THRESHING DOUGLAS FIR CONES

When facilities do not permit sending the entire cones in to the kiln house, the ranger threshes the cones where they are collected, thus leaving only the seed to be sent to the main station. Although not so advantageous in many ways, this method allows large quantities of seeds to be brought from the outposts which would not otherwise be available. (Fig. 2.)

cases larger quantities of cones than the usual sample were collected from particular trees for use in special supplementary studies. The various steps in the study have yielded voluminous data on the cones, seeds and seedlings, only the general nature of which can be indicated here.

THE CONE AND SEED

1. Study of the green, unopened cones, their condition and color; measurements to obtain the "number of cones per bushel" and "number of bushels per tree."

2. Drying of the cones; extraction and cleaning of the seed. Records were made of the amount of uncleaned and cleaned seed per sample, per tree and per bushel of cones.

3. Seed study. Counts, weights and measurements to determine size of seed; number of seed (with chaff, mill-cleaned and hand-cleaned) per pound and per bushel of cones; cutting tests to determine purity.

4. Germination. Tests made in the greenhouse during the winter of 1912 were unsatisfactory. A sample of 300 seeds from each lot was therefore sown in the nursery in the spring of 1913 for outdoor germination, and this proved perfectly reliable. Such a test has been made each spring since 1913, and will be repeated annually so long as there remains sufficient seed in any of the

original lots. Uniform storage conditions have been maintained from the beginning.

THE SEEDLING

For the purposes of this study it is the behavior of the seedling in the nursery, and more especially its behavior as a growing tree in its ultimate place in the planting site, which forms the basis of final judgment upon the desirability of that seedling. In order to secure material for the study of this behavior, the seedlings of 1913 and 1914 were observed for two years in the nursery and then out-planted on various sites to form permanent forest stands.

Series of 1913.—The seedlings resulting from the germination tests of 1913 were closely watched in the fall of that year to determine the time of winter bud formation or "hardening." In the spring of 1914 they were transplanted in the nursery and at that time a number of seedlings was taken at random from each lot for minute study and comparison. In the fall of 1914 the height growth was recorded by measuring every tenth plant in the beds, and the process of "hardening" was again observed.

In the spring of 1915 the plants, then two years old, were lifted for final planting in six different sites in four different geographical regions. Ten representative plants of each lot were again taken for intensive laboratory study. Twenty plants of each lot were sent to each of these sites, making a total final planting of 120 trees for each original seed tree from which cones were gathered. For twelve of the original trees, possessing features for which broader averages were desired, from 50 to 100 transplants were set out in each site. The plants were spaced 7 feet apart each way. Each plantation covers an area of nearly four acres and contains approximately 3,400 pedigreed plants, each of which is marked with an aluminum tag bearing the original parent tree number and the individual number of the seedling in its row. The total number of plants of the 1913 series, outplanted in 1915, is thus 20,400.

Series of 1914.—In order to strengthen the whole study, the entire procedure outlined above was repeated with the seedlings of the 1914 germination series, each operation following the similar operation in the 1913 series by just one year. In the final outplanting to the same sites in 1916, however, only ten plants for each parent tree were set out in each site, since it was believed that this number was sufficient to serve as a check upon the 1915 plants.

PLANTING SITES

The permanent planting areas, and the features for which they were selected are as follows:

1. Northern Cascades: On the Snoqualmie National Forest; 40 miles east of Everett, Washington, on the South Fork of the Stillaguamish River; altitude, 1,900 feet.
2. Middle Cascades: On the Columbia Forest; 7 miles north of the Columbia River; altitude, 1,200 feet.
3. Middle Cascades for altitudinal range: Three areas on the Oregon Forest; 5 miles southwest of Mt. Hood, on the headwaters of the Sandy River:
   I. 2,800 feet elevation, north slope.
   II. 3,700 feet elevation, north slope.
   III. 4,600 feet elevation, north slope.
4. Coast Region: On the Siuslaw Forest, in the coast range (Mt. Hebo); 20 miles south of Tillamook; altitude, 2,000 feet.

RESULTS

The results of the study fall naturally into two divisions, the first including the statistical data concerning the cones, the seed, and the germination and behavior of seedlings in the nursery; the second embracing the development of the seedlings in the final field plantations.

The results of that portion of the study dealing with the cones, the seed, and the seedling in the nursery have been exhaustively presented in a progress report written in 1914 by C. P. Willis.[2] The great range of conditions

[2] For the substance of this official report the reader is referred to the article, "A Study of Douglas Fir Seed," by C. P. Willis and J. V. Hofmann, in the Proceedings of the Society of American Foresters, Vol. x (1915), pp. 141–164.

DUMPING DRIED CONES INTO ELEVATOR

After the cones are collected, they are brought to the kiln house where they are placed on trays and put in hoppers which carry them to the shaker, where the seeds are removed. (Fig. 3.)

represented by the parent trees made possible so large a number of comparisons and factor combinations that eighty-three tables were compiled to express graphically the numerous relationships. The interplay of the factors involved can be indicated by listing them in juxtaposition:

Age of the parent tree. Size of the parent tree. Health of the parent tree. Growing space of the parent tree. Altitude of the parent tree. Latitude of the parent tree. Soil quality of the site.	Seed: (a) Yield of cones per tree. (b) Size of cones. (c) Yield of seed per tree. (d) Size of seed. (e) Quality of seed, germination per cent. Seedling in nursery: (a) Establishment. (b) Size of seedling. (c) Rate of growth. (d) Hardiness.

It will be appreciated that not all the first column factors will affect all the points in the second column, and also that such a feature as "size of seed" might influence both "establishment" and "size of seedling" in its own column. It is not possible, within the limits of the present article, to discuss the detailed conclusions, but some idea of their trend can be given by a consideration of their practical application. The tabular comparisons were variously decisive, but, on the whole, the results have served to formulate a number of recommendations for cone collection and for the selection of seed trees. These recommendations are not regarded as final, for it is almost certain that the future development of the plantations will change some of our present ideas. European experience has shown that such long-lived plants as forest trees require some years to reveal their hereditary traits. In Sweden, for example, the failure of many plantations from imported seed did not become evident until twelve or fifteen years after planting. The following recommendations are based upon two years' study of seedlings in the nursery. It seems inevitable, therefore, that the observation, through many years, of the same seedlings in various field plantations must result in some reversal of opinion and in the disclosure of facts at present unthought of.

1. Gather cones in a locality as cold as or colder than the planting site. The colder the habitat of the parent, the stronger is the tendency of the seedling toward early maturing of growth.

2. Collect from open-grown trees where practicable, since such trees produce larger crops of cones, larger yields of good seed per bushel of cones, and larger two-year-old seedlings than do forest-grown trees.

3. Seek large cones where practicable. Large cones have large seeds which offer better chance of seedling establishment and produce large first-year seedlings. (This advantage of size is usually lost in the second year.)

4. Collect from young or middle-aged, small or large trees, as convenience demands. Young trees produce large seed and vigorous seedlings; such trees are easy to climb and permit rapid work in collecting.

5. Avoid trees growing on poor soil. Such trees give low yield of good seed per bushel of cones. Seedlings also seem to inherit a stuntedness of growth.

6. Avoid extremely high altitudes in collecting unless the ultimate planting site is very high. High altitude trees generally give small yield of good seed per bushel of cones.

7. Avoid trees diseased by fungous growth, "conky" trees, for these give low yield of good seed, and the seedlings are inclined to be stunted. Until this point is cleared by further study, it is safest to assume that the tendency to disease, or rather the lack of resistance to disease, is hereditary.

8. Avoid insect-infested cones because of small amount of good seed. Insects work rapidly and the damage is worse if the cone crop is light for the locality,

GENERAL VIEW OF SEED KILN

Located at Wyeth, Oregon, the Wyeth Seed Kiln is typical of the type of plant where the Douglas fir seeds are prepared for germination. (Fig. 4.)

because the insect attack is then concentrated.

SELECTING TIMBER SALE SEED TREES

With the exception of the factors of soil quality and health of the tree, all considerations in this matter can be subordinated to commercial expediency. Since every tree left on a cutting reduces the lumber yield of the area to the extent of its own merchantable volume, it is essential to leave as few trees as are necessary to assure the reforestation of the area. The best seed tree, therefore, from the lumberman's standpoint, would be one which is worthless for lumber, hence a tree which is either defective or below merchantable size.

From the standpoint of the silviculturist, the best tree to leave would be the one which produces the greatest quantity of good seed per tree. The present study indicates that medium-aged (200–300 years), rather large trees (3 to 4 feet in diameter) produce five times as much good seed as very small young trees or very old large trees. Unfortunately, such trees are also the most valuable for lumber and consequently the most costly to leave.

Young or old trees can be left as seed trees, but the number left should be guided by the amount of seed produced as just stated.

Open-grown trees should be preferred. These yield more seed and better seedlings, and are also more windfirm than forest-grown trees.

Avoid, if practicable, leaving trees which grow on local patches of poor soil. These yield less seed and smaller seedlings than trees on good soil.

Avoid leaving diseased trees. These produce less good seed and smaller seedlings than sound trees, other things being equal. There is also a possibility that the progeny of such trees will be of low vigor in resisting disease.

Regarding the last rule little can be declared with certainty. Whether the tendency to disease is inherited; whether this tendency, if inherited, is offset by giving the offspring the advantage of a more favorable environment; and whether we actually lower the quality of the forest by leaving diseased seed trees—

SEED BED FRAMES MEAN SAFETY FOR SEEDLINGS

Frames are constructed with burlap sides and shaded tops which insure even germination. Covered with wire netting, rodents and birds are unable to gain entrance. Care and attention paid to seedlings assures a sturdy growth for transplanting. (Fig. 5.)

these questions constitute a problem of vital importance and absorbing interest. It is not possible to draw positive conclusions from three or four years of work. It is hoped that the future development, on the different planting sites, of the seedlings from diseased parent trees will throw some light upon this problem. It is planned, moreover, to amplify this phase of the study by the collection of seed in the fall of 1917 from a considerable number of diseased trees, and from an equal number of trees which are sound but otherwise as similar as possible to the diseased trees. The pathology of the diseased trees will be carefully studied and the whole conduct of the work will be more intensive than was the case for this particular phase of the present study.

RESULTS FROM FIELD PLANTATIONS

The compilations of the growth measurements for two years in the 1915 plantations and for one year in the 1916 plantations have served only to emphasize the impossibility of drawing conclusions from such short-time observations. There were no consistencies which can be cited as even indicating the possible trend of differences among the various classes of trees. It is too soon to expect the true hereditary qualities of the trees to appear in any measurable degree. At the end of the first five years, however, detailed compilations will be made which are expected to yield at least indicative results. At the end of twenty years the problem, for immediate practical purposes, should be solved.

It is a superior merit of Government research that the element of time need not hamper the plan or ultimate conduct of an important study. In the present instance it is planned to make observations of the field plantations for at least forty years, and in all likelihood it will be found that valuable data can be ac-

cumulated through one entire "management rotation." Such a rotation will probably mean, for Douglas fir, a period of 120 or 150 years. The imagination refuses to venture concerning the methods of study at so distant a time. The largeness of the idea is at once gratifying and disturbing, for one feels both the importance of the work and the responsibility of doing rightly the early steps in that work, lest the initial errors and omissions grow in magnitude with the advancing years.

ACKNOWLEDGMENTS

The plan for the seed collecting and seed testing of the Douglas Fir Seed Study was prepared in 1912 by Thornton T. Munger, then Forest Assistant at Portland, Oregon. The conduct of the seed collection and all of the first year's work was under the direction of C. P. Willis, of the Wind River Experiment Station. His careful work with the cones and seeds was productive of the detailed conclusions upon that phase of the study. He has also prepared a report on numerous incidental studies relative to methods of cone drying, seed extraction and time of cone gathering. Since 1913 J. V. Hofmann has been Director of the Experiment Station and has had general supervision of the work. He planned the field plantations and selected the sites for the altitudinal and regional tests for hardiness and growth of seedlings. The writer's connection with the study began with the collection of a portion of the cones, and has continued to the present time. The article by Mr. Willis and Dr. Hofmann in the *Proceedings* has been freely drawn upon in the present writing.

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4. The Effect of the Source of Seed upon the Growth of Douglas Fir, by Count von Berg, Sagnitz, Livonia, Russia. A report submitted to the U. S. Forest Service, from whom von Berg secured the seed for his study. (Abstracted by Raphael Zon in *The Forestry Quarterly*, Vol. xi (1913), pp. 499–502.)

5. Versuche über individuelle Auslese bei Waldbäumen I, *Pinus silvestris*, by Dr. E. Zederbauer, Austrian Experiment Station, in *Centralblatt für das gesammte Forstwesen*, May, 1912, pp. 201–202. (Studies of the Individual Heredity of Forest Trees. Reviewed in *Forestry Quarterly*, Vol. x (1912), p. 733. "Part II—*Pinus austriaca*" reviewed in *Forestry Quarterly*, Vol. xi (1913), p. 418.)

6. The Influence of Age and Condition of the Tree Upon Seed Production in Western Yellow Pine, by G. A. Pearson, U. S. Dept. of Agriculture, *Forest Service Circular* 196 (Jan., 1912.)

7. Annual Reports of the American Breeder's Association, Washington, D. C. These reports contain valuable reports and reviews by the Committee on Breeding Nut and Forest Trees, many of which are pertinent to the present work.

8. The work of a number of European investigators may be found as follows:

Prof. A. Cieslar: *Centralblatt für das Gesammte Forstwesen*, 1907, p. 1.

Dr. Dengler: *Zeitschrift für Forst und Jagdwesen*, 1908, p. 137.

Prof. G. Huffel: *Revue des Eaux et Forêts*, 1912.

Dr. M. Kienitz: *Zeitschrift für Forst und Jagdwesen*, 1911, p. 4.

Cooperative Move to Improve California Citrus Orchards

Six years of study have proved that more than 25% of the trees in California citrus orchards are unprofitable. They are undesirable bud variations that bear little or nothing. The California Fruit Growers' Exchange has now established a department of bud selection, the object of which will be to secure and furnish to all growers buds from tested trees, in order that they may propagate only desirable strains of oranges. This is a unique instance of widespread application of the teaching of modern plant-breeding.

RACIAL VALUES IN THE WAR

France and Great Britain Seem Least Able to Make Good Their Losses—Future Lies in Hands of Germans or of English-Speaking Peoples Outside of England—Need for Eugenics

Review of a Book by Seth K. Humphrey

THAT the Great War will markedly affect the future history of the world is universally recognized, but the exact nature of the effect is not so often discussed. Seth K. Humphrey devotes much space to it, in an interesting series of essays[1] which serve as an introduction to eugenics. He concludes that England and France have passed their highest points, and that the future belongs to the Germans or the extra-Brittanic Anglo-Saxons, that is, America and the English colonies.

A relatively small loss of men will seriously cripple a nation, he points out, if these men are the best she has.

"Someone has said that if France were to lose fifty of her greatest statesmen, fifty leading scientists, fifty each of her shining lights in education, art, music, and so on, there would be nothing left of France. This states in an exaggerated way a deep truth which can be far more convincingly illustrated. We may continue with France as an example, although the case fits England, Germany, and America as well.

"The population of France is about forty millions. Then, instead of a few hundred suppose France were suddenly to lose four hundred thousand, 1%, of her very best in human values; not of the physically best, such as are being lost in the horrible war, but of the best in intellectual and creative ability, in leadership, in genetic worth. What would be left of France? Gather in every man and woman in France who leads, sustains, creates, and brings to pass the things that are vital to her life; then to the sum of all these add as many of equal potential worth, who in the nature of things would succeed them; and still this 1% conscription of France's best would be unfilled. Add, again, the most promising child in every family that has ever produced exceptional ability; it is doubtful whether then the list of four hundred thousand would be complete.

"This idea is so pertinent that it cannot be impressed too strongly. Take the illustration to England—eliminate a half million of her active and potential leaders; and to Germany—subtract six hundred and fifty thousand from her best genetic values. What would be left of Europe?

AMERICA'S LEADERS

"Bring it home to our own United States. One per cent of the population is one million. Ten times this many physically fit could be raised to defend their country, but could we find a quarter of one million who have a vital, constructive part in the making of it? If so, remove these from the nation's life, and then, to complete the lists, three times as many more chosen from the most promising of the country's blood. What would be left of the United States?

"A smaller unit may bring the idea closer. In New York City is supposed

[1] Mankind—Racial Values and the Racial Prospect, by Seth K. Humphrey. Pp. 223, price $1.50 net. New York, Charles Scribner's Sons, 1917. Mr. Humphrey, a Boston business man and author but a serious student of biology, outlines the problems of eugenics in the most elementary terms possible, dispensing not only with references to authorities but even, for the most part, with citations of facts. While the book is admirably planned and, on the whole, shows notably sound judgment, the addition of more statistical data would have added to its value. Although many of Mr. Humphrey's conclusions are naturally open to question, his point of view is so intelligent and so lucidly set forth that it is to be hoped he will follow up this essay with a more detailed and documented study.

to be concentrated much of the country's ability. A list of one hundred would include New York's really big men. The names of not more than one thousand would be generally recognized in the country at large for actual achievement. 'Who's Who in America,' with its fine-tooth comb, finds less than four thousand men and women worthy of its not too discriminating pages. New York is popularly considered as swarming with financial and industrial magnates. Within the limits of a thousand one could put all its leaders of finance and captains of industry, and still have places to spare.

"Yet the toll of 1% would call for *forty thousand* of New York's best. What would be left of New York?

"It seems incredible that the loss of only one individual in every hundred could so devastate human values in any vigorous nation. But we are wholly misled in our estimate of a nation's strength by the always satisfactory proportion of its physical vigor. Physically, a people can hold its own almost indefinitely. In the physical display which any active nation can make we lose sight of the rather appalling fact that its constructively effective brains are concentrated in the heads and inheritances of an unbelievably small number."

Of course it is frequently objected that the visible ability does not represent all the potential ability. There are many, it is supposed, who would rise if they had the chance; they are the mute, inglorious Miltons who through lack of education or through economic difficulties have never been able to reveal to the world what there is in them.

This objection rests on doubtful ground, genetically. Nevertheless, it may be allowed for. "Suppose we make this allowance generously and assume that, for every individual who develops exceptional capacity, there are ten sources from which his like might possibly rise; in other words, raise our estimate of sustaining inheritances from 1 to 10%. Then, for a single convincing example, make the toll from Greater New York 10%—four hundred thousand of her best in genetic values. Does the wildest optimist believe that New York's population would then hold anything more of racial promise than the decadent populations of the Mediterranean?

"It is a startling thought that inheritances of the quality essential to the effective maintenance of civilization are lodged exclusively with a scant 10% of the population. Yet that is the logical conclusion if we accept what appear to be plain facts."

THE POSITION OF FRANCE

Now in estimating the probable effect of the war on the various nations involved, it must be asked how much they can afford to lose? Are they eugenically sound and likely to be able to make good the racial damage which they will incur? Mr. Humphrey begins his study with France.

"Race mixture has not been much of a degenerating influence in France. Her race values have gone down under the long-continued failure of her best stocks adequately to perpetuate themselves. Compared with the other great nations of Europe, France has had longer periods free from tormenting wars—periods given over to the advancement of culture and to the enjoyment of it. Luxury has had more time and opportunity to play havoc with her race values, and in this, luxury has been assisted by the very quality of French temperament which has made the glory of French culture. No new blood can come to France—her resources are within the realm. Her African possessions are more of a drain than a prop to her racial vitality.[2] Her decline is not to be stayed by a forced rise in the birth rate; numbers secured in that way add nothing to race values. Her handful of effectives is shrinking—as those of her rivals are shrinking, only faster—and no agitation over birth rate can set the effectives of France, or any other nation for that matter, to mending their ways. France is nearer to the critical disproportion between her con-

[2] This is not true of North Africa. The birth rate in Algeria is relatively high and the population shows much of the vigor that is expected in a new country.—THE EDITOR.

structive and non-constructive elements than either of her greatest rivals—England and Germany. We can speak here of France and England as rivals, for a racial study may ignore alliances and look upon war as a dreadful episode, working disaster to the race values of all, but changing little the race relation by either victory or defeat."

"The outstanding fact for this inquiry is that France is not to be a source of future ability to make good the wastage of present civilization. We must look to peoples whose human values have not been so long and persistently exploited. France's contributions to the world's advancement may continue, but the days of her greatest achievement are in the past. Long before the world is over-hard pressed for sustaining race values, France will have ceased to be a dominant factor in its civilization.

GREAT BRITAIN

"Great Britain is pre-eminently the country of extremes in racial values. No other country excels her in the production of able men, in the adequacy of their numbers, and the genetic richness of the stocks from which they are derived. Yet Great Britain has a higher proportion of ineffective, underbred, hopelessly inferior white stocks than any other dominant nation.

"We are not interested here in the political significance of this condition, nor in the sectional exclusiveness, the persistent social isolation of types, which have carried differentiation of genetic values in Great Britain to unprecedented lengths. Let us take the condition as it exists.

"No great power has come to permanent disaster solely through the increase of its unsocial population. There must be also a drop in its effective values. One able man outnumbers a hundred ineffectives in the control of any situation not actually developed into a riot and the mob is the most effervescent of any manifestation of power. England is keenly alive to the threat of her racially depreciated masses—in London's East End, in Liverpool, Manchester, Glasgow, in the substratum of her agrarian population, and throughout all her manufacturing and mining regions; not the steady workers, but the hordes of intermittents and unworkables effective only at the business of reproducing their kind, adding misery to misery unceasingly. They make for England a social problem that is already a severe tax upon her resources of control, and will become more imposing when the war ends. Yet they will never get their hand upon Great Britain's helm until failure of her best stocks compels the last remnant of her dominant blood to let go. If England can devise a way to reduce the fecundity of her ineffectives she may lighten her social burden, but for the preservation of her national life she must look to the adequate perpetuation of the high genetic values which supply her with able men.

"Thus Great Britain's approach toward a critical disproportion between her sustaining and her socially dependent stocks is an arithmetical certainty. As with France, the time of her arrival cannot be computed in years, or decades, or centuries. This war has disclosed the remoteness, not the nearness, of her downfall. We simply know that the racial values of Great Britain are distinctly on the wane, and that unless something occurs to reverse her racial trend she will have been counted out in favor of less debilitated peoples long before the world loses the last of its Aryan civilizations.

"But the superb English inheritance has gone to all parts of the earth, to develop the traditional English resourcefulness long after the home stock shall have been depleted of its effective values. England's contribution to the world's genetic values is to be her crowning achievement. The great civilizations in North America, Australia, New Zealand, South Africa—in the generations to come, any one of these may grow to be another England in world strength. If under a new conception of human relations these English-speaking peoples yield their small differences and get together in singleness of purpose, the dominating world civilization for unnumbered centuries to come will be English in language and in those qualities which have made England great.

Upon this union depends the survival of individualism in its most wholesome aspect.

RUSSIA'S OUTLOOK

"Russia, because it is a land of immense numbers and unknown racial values, is popularly regarded as a mighty reservoir of human possibilities, awaiting only better environmental conditions for their expression.

"This is presuming on ignorance. Because Russian capacities seem to be mostly untried, it is not safe to assume either that they do or do not exist in quality fitted for a self-sustaining development. The Slavic masses of Russia, like every other people from Hottentot to finest Aryan, come to a higher level of existence under improved conditions, yet we have learned that very few, even among the ablest races, actually contribute to the maintenance of that higher level. Our inquiry is not for peoples capable of *receiving from* civilization; it is for the few capable of giving to it. This indicates the question which we now ask of Russia.

"To begin with, we must distinguish between the numerous and variegated Slavic peoples of Russia, and the half-Teuton handful that not only dominates but is the Russian Empire as we know it, so closely is it identified with everything constructive in Russian life. Russia may be said to be an Asiatic monster with a half-European head. It is in the monster, not in the head, that Russia's unknown racial values lie.

"Russia embraces a most heterogeneous population of one hundred and fifty million people, two-thirds Slavic, nearly one-third ranging from strong infusion of Mongolian to Aryan mixtures with inferior stocks of unknown origin. In the absence of any definite racial history, we are compelled to estimate Russia's inheritance values largely by inference from the degree of progress she had made in her contracts with other peoples of Europe.

"A strong argument against the possession of any high degree of initiative and creative capacity by the Slav is in the very fact of his continued submission to domination by groups essentially foreign in blood. No true Aryan stocks leave the expression of their national, commercial, and industrial life so generally to a foreign element. The natural inference from this condition is that the Slavic inheritance does not well compare with the Teutonic in the qualities adapted for taking a leading part in civilization.

"Another convincing evidence of the inferior quality of the Slavic inheritance is in the slight contribution the Slav has made to the world's attainments. From her manufacturing processes to her art, everything that is best in Russian life is borrowed. Even the example and inspiration of his European overlords have not led the Slav to a degree of self-expression that gives promise of any unusual future for his people.

"It is too early—a generation too early—to assume that the recent overthrow of the Czar and his government means a democracy for Russia. We might as well have hailed Mexico as a glorious democracy when Maximilian fell. Illiterate Russia has many years of painful struggle, of slow education, ahead of her before she can even determine the capacity of her suppressed millions for self-government. The revolution was directed against Germans and Pro-Germans; there is unquestionably a strong Teutonic infusion in the Slavic upper classes that is Pro-Slavic, and will act with the new regime. Russia may have a more liberal government, but for years to come it will be such as the Teutonic-Slavic ruling class chooses to give her. True democracy is a dream for a people three-quarters of whom are decades away from adequate self-expression.

"To whatever heights the Slav may attain, the indications are that those heights will be below the level of the pure Aryan. No persistent borrowers or imitators of the Aryan civilization are destined to supplant the Aryan so long as he maintains his racial integrity. Mere numbers will never command his homage."

THE VIGOR OF GERMANY

"Germany, from the viewpoint of racial values, is the most interesting of

all the Aryan groups in Europe. In development of her inheritance she is the youngest—and youth is always full of possibilities."

"Germany's advantage is in the newness of her vigor, the abundance of her developed ability, and the small proportion of her human dross. Germany has mistaken these for symptoms of racial superiority. While there is nothing in them to raise the world's civilization into realms unattained, they do assure to Germany a very significant length and strength of racial life for the attainment of those ideals of which the German inheritance is capable. They give to the German a survival value which other Aryan stocks in Europe do not possess. For this reason an estimate of Germany's exceptional prospects for survival should be of especial interest.

"Germany's survival values can be more safely measured against those of other peoples than in terms of years or centuries. In casting about for comparisons, it becomes evident that Furope has no stock that seems to promise the lasting quality of the German. But in America, Australia, New Zealand—in the stocks which for centuries have been going out from Great Britain to develop her possessions—there is the vigor and richness of genetic values that usually attend migration and selective development under natural conditions. These stocks bid for a future in every way comparable with the future of the German."

There is likely, then, to be a long struggle between the Germans and the English-speaking nations for world supremacy. "The decision, if it must come, will eventually rest upon survival of racial values. What, then, are the comparative racial prospects of Germany and the various English-speaking peoples?

"One outstanding difference is that Germany, self-sustained, fully populated will continue to hold an advantage she has held from the beginning, in being able to maintain the integrity and purity of her stocks against deteriorating mixtures. Without exception, the younger English-speaking peoples—and even England herself—have sought in varying degree the temporary advantage that comes from importing inferior stocks to do their less pleasant tasks.

HANDICAPS OF AMERICA

"Let us consider first our own racial prospect. In the three preceding chapters we have studied the results in the United States of this commercially profitable but racially suicidal mingling of unlike peoples. The African infusion, and the past, present, and future importations from non-progressive foreign stocks, together constitute what might be called an extraneous load upon our racial values. It is significant that a similar load of anything like its proportions does not rest upon any other English-speaking peoples, except, perhaps, South Africa. This seems to be a special handicap put upon the United States of America. Although disproportionate increase of superior and inferior stocks remains the chief factor in racial depreciation among all civilized peoples, our own special handicap is not to be passed over lightly. The tendency of twenty or more distinct peoples to maintain a relative separateness of ideals, while living as neighbors and outwardly subscribing to American citizenship, is only a few degrees less threatening than would be a free intermixture of all their inheritances. A long and persistent intermixture would tend to develop social unity in the much-heralded "true American" of the Melting-Pot, but may heaven preserve us from a unity that comes with the passive worthlessness of a downwardbred mongrel type. We can better afford racial separateness, with all its menace to social peace.

"Yet these rigid alternatives hold us to a most perplexing condition of suspended effectiveness; a workable social understanding cannot be forced against the persistent separateness of so many peoples, while a decent regard for the future of the race should turn us from the dull harmony of mongrelism. There seems to be no way out; but that very fact should restrain us from getting any farther in. In the light of present knowledge, further loading up with inferior stocks would be deliberate suicide.

"Whatever we may do to check further disastrous type mixtures, our disadvantageous start in this matter is bound to affect our future position with respect to both Germany and the English-speaking peoples. Yet against these racially and socially disquieting influences, the United States still has Aryan[3] values as effective as those of any inheritor of England's widely distributed legacy. Those early stocks were of the sort of genetic material to build a great republic. What if they did not foresee our careless invitation to peoples who could never respond harmoniously to their lofty ideal of culture? They thought that this was to be a land for their children's children, and they did their best to carry out the idea by following the Biblical injunction to the people of the earth. They were prolific; their increase overflowed westward again and again, as far as the Pacific coast, and their descendants in turn, effectively mingled with the sturdy product of the earlier migrations from northern Europe, have endowed this country with a fund of genetic values that needs only to be maintained—even in its present proportion— to insure permanence to the most fortunately situated people on earth. But to hold these values to their present proportion is the most difficult order ever put up to the American people.

CANADA'S ADVANTAGES

"Of the other English-speaking countries, Canada is a land of material opportunities comparable in many respects with our own. Racially she has the advantage of us in the purity of her British-descended stocks, and in the prospect of continuing that purity if she has the wisdom to choose to do so. The cloud on her racial horizon is her legacy of original French stocks, which persist in remaining at a genetic and cultural level below that of the dominant English-speaking population. They may fill a worthy place in Canada's economic scheme, but they do not furnish their proportion to the essential ability of Canada's people, and to that extent are a hindrance to her racial future.

"But in Canada, as with us, the Star of Empire has moved westward; and in that great West is the purest and best of her Aryan inheritances, needing, as ours, only to be perpetuated to make of Canada one of the great peoples of the world.

"The racial difficulties of South Africa do not augur well for her place among the English-speaking communities of the future. Her dominant people have displayed an admirable comprehension of race values in attempting to stay the almost overwhelming flood of inferior stocks, but the odds against them are so immense that nothing short of revolutionary tactics will save South Africa for a great Aryan future.

"The pure white of India is an exotic, and can never be anything else. Neither India nor any tropical country has an Aryan future. The beautifully mystical culture of India is essentially non-Aryan, and is not under discussion.

"In Australia and New Zealand we come again to lands brilliant in promise of a great future for the English-speaking Aryan. Both have their race problems, and both are meeting them with conspicuous intelligence. Countries of dimensions so magnificent, with resources scarcely touched and peopled by British stocks still in the full vigor of youth, have only to conserve the one and adequately perpetuate the other to make sure of a future well out into the unknown that lies ahead of us all.

"The United States, Canada, Australia, New Zealand—four young giants of the earth, growing and with abundant resources for further growth. Were these four, with England as their mutual bond, joined in singleness of purpose to carry forward to still greater achievement the humane culture that distinguishes the English-speaking Aryan, who could effectually set up against them? Germany has youth, but it is the youth that compares well with the old age about her, not with these four

[3] It is unfortunate that Mr. Humphreys could not bring himself to give up the idea of an Aryan race, which has long been abandoned by ethnologists. When he says Aryan he usually means Nordic.—The Editor.

lusty sons of Great Britain. Germany may more easily preserve the purity and strength of her inheritance within her realm, but her realm is full and her overflow must go out to an inevitable mingling with other peoples, unless by sheer force she gains foothold on forbidden ground. Any one of these four English peoples has undeveloped resources greater than the resources of all Germany. But resources alone determine nothing in human affairs; they are the instruments of resourceful peoples. What is more clear, then, than that English-speaking peoples, with their superior opportunities, have only to perpetuate their genetic values in order to make sure of a predominating influence in the future civilizations?"

NEED OF RACIAL ALLIANCE

"So we look out upon a future clouded with perplexities which can scarcely be defined. Against that uncertain future we must prepare. An unshakable bond of mutual understanding between the speakers of English is the most obvious preparation. But that alone will not suffice. We know that in the affairs of men mere numbers are of little avail, and the accumulated trappings of civilization have in themselves no lasting strength. The source of all strength is in an abounding racial vigor. It is the one sure reliance for the meeting of whatever may come. It is the motive power behind all successful human effort, and the failing of it is the palsy that marks nations for destruction.

"The truth of these things is making uneasy those whom superiority has heretofore made confident. They are beginning to see that without racial strength the mere numbers of the world's inferior hordes might indeed prevail against them.

"The threat of racial failure has given life to a new enterprise for the conservation of human values—Eugenics, 'Wellborn.' So far it is the beginning of a promise. But in its main idea are possibilities now unthought of, awaiting only man's necessity and determination, to serve the race."

The Journal of Heredity During the War

Paul Popenoe, the editor of the Journal, whose active and painstaking efforts during the past three years have built it up, has been drafted into the military service of the country, and he has been granted leave of absence for the duration of the war. Herbert Popenoe has been appointed assistant editor, and it is believed that the Journal can be regularly issued, notwithstanding the absence of the editor, providing the members of the Society take their full war share of the responsibility for the Journal and furnish manuscripts which are adequately illustrated and of a wide general interest.

The Society is holding its own and making a steady growth, and the increase in interest in matters pertaining to the new science of genetics as a secondary result of the war will, I believe, experience a phenomenal growth as the war continues and, after the war, lead to many important changes which we as little comprehend now as we realized nine years ago that the flying machine of the boys of Dayton would be the greatest factor in this terrible struggle.

To lessen now the research work or the interest of the public in the science of genetics will in my opinion prove as shortsighted as the too practical policy we have pursued to our sorrow in the education and treatment of our analytical chemists.

As the head of the Aviation Construction Board remarked to me a few days ago, this war has become a war of the scientific men—the professors—the real technical experts and specialists.

The JOURNAL OF HEREDITY aims to interest the young men and women of the country in the great subject of genetics and encourage those who have research abilities to enter this constructive biological field for invention and discovery. It is more needed now than ever, and every effort will be made to enlarge and extend its influence.

DAVID FAIRCHILD,
President.

THE ANNUAL CATALOGUE OF PLANT IMMIGRANTS

Many Additions to Our Food Plants are Being Made by Office of Seed and Plant Introduction—To be Available Gratis to all Serious Experimenters Who File Application

David Fairchild

Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, Bureau of Plant Industry, U. S. Department of Agriculture

THE war is demonstrating in a striking way the danger of being too practical. The technical knowledge required today to fight this war is touching everywhere the borderland of knowledge as never before, and there is hardly a specialist, no matter how narrow the field is in which he works, but has been called upon to furnish information of some sort.

Mankind has become willing as never before to listen to every suggestion and follow up every clue which may lead to important discoveries bearing on the war.

Changes in agriculture will necessarily come with the changes in transportation and the perfection of the farm tractor.

In order to get ready for these changes much experimentation will be required and thousands of men on their own places are needed to do this work. To expect this work to be done by state experiment stations and the Government agencies, and wait for these men to do it, would be like waiting upon the Government to discover the aerial highway. Individual initiative flew the first aeroplane and individual hybridizers will originate many new plant varieties.

The Government, through its Office of Foreign Seed and Plant Introduction, brings in every year several thousand species and varieties of plants, gathered from different parts of the world. These are for a wide trial in those parts of the country where they are likely to thrive.

The seventh Annual List of these plant immigrants is appearing in a few days and will be sent to *bona fide* experimenters all over the country. A few photographs, illustrating some of the economic and ornamental plants described in this 1917 Annual List are reproduced here in the Journal. There are 1400 interesting new plant introductions contained in this Annual List and applicants for it will be supplied up to the limit of the edition.

All plants listed are sent out gratis, on request, after adequate information has been received proving the capabilities of the applicant to take care of and experiment with these rare species and varieties.

It should be kept in mind that all plants described are newcomers to this country, and are, for this reason, experimental. No one should imagine that immediate profits are to be made out of them, and those whose interest is chiefly in the money end of the problem—who are first of all practical and after that plant lovers or investigators—will be too impatient for results to make good experimenters and cooperators of the Office of Seed and Plant Introduction.

Everyone who really loves, and knows how to grow and care for new plants, should get in touch with the Office referred to, and if the supply holds out get a limited number of the new introductions which in the opinion of the office experts have a good chance of succeeding.

ORCHARD OF HARDY OLIVES IN THE CRIMEA

An Olive Orchard at Nikita, in the Crimea, which has stood practically uninjured temperatures of —2° F. at intervals for 60 or 70 years. (S. P. I. No. 27172.) Seedlings from this orchard should show unusual hardiness and may succeed in sections where other olive varieties have failed. (Fig. 6.)

As explained in the Annual List, all plants sent out are accompanied with special descriptive permanent labels, which are a great help to experimenters in keeping fresh in their minds the particular uses for which the plants were introduced.

Correspondence should be addressed to the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

The following information is necessary and must be supplied on special Experimenters' Cards which will be sent to applicants on their request, before requests for plant material can be filled:

Permanent address: All plants are sent out by parcel post, not by express. Do you wish plant material sent to above address? If not, fill out permanent mail address for plant material. How much land have you available for experimental planting and how much do you wish to devote to such planting? Is this land owned or leased by you? Have you a water supply for irrigation purposes? Have you a green house? Are you interested in experimenting with: Grains; forage plants; fruit trees; small fruits; vegetables; shade trees; ornamental trees or shrubs; perennial flowering plants; annual flowering plants; house plants? If so, state below which you are especially interested in. Give your experience in caring for and experimenting with plants.

THE MURASAKI VARIETY OF JAPANESE FLOWERING CHERRY

The double-flowered cherry trees of Japan are preeminently trees for dooryards and small parks, and should be planted near garden walks, so that people can walk under them and enjoy close at hand the loveliness of their exquisitely delicate coloring. They are no more showy than our crab-apples when seen at a distance. The Murasaki (*Prunus serrulata*) S. P. I. No. 45056, is a deep-pink mid-season, very free-flowering variety (April 20 in Maryland). The blossom centers turn red with age, and the petals fall in great abundance turning the ground pink beneath the trees. In autumn the foliage turns a golden yellow. Photographed by Fairchild, twice natural size. (Fig. 7.)

THE OJOCHIN VARIETY OF JAPANESE FLOWERING CHERRY

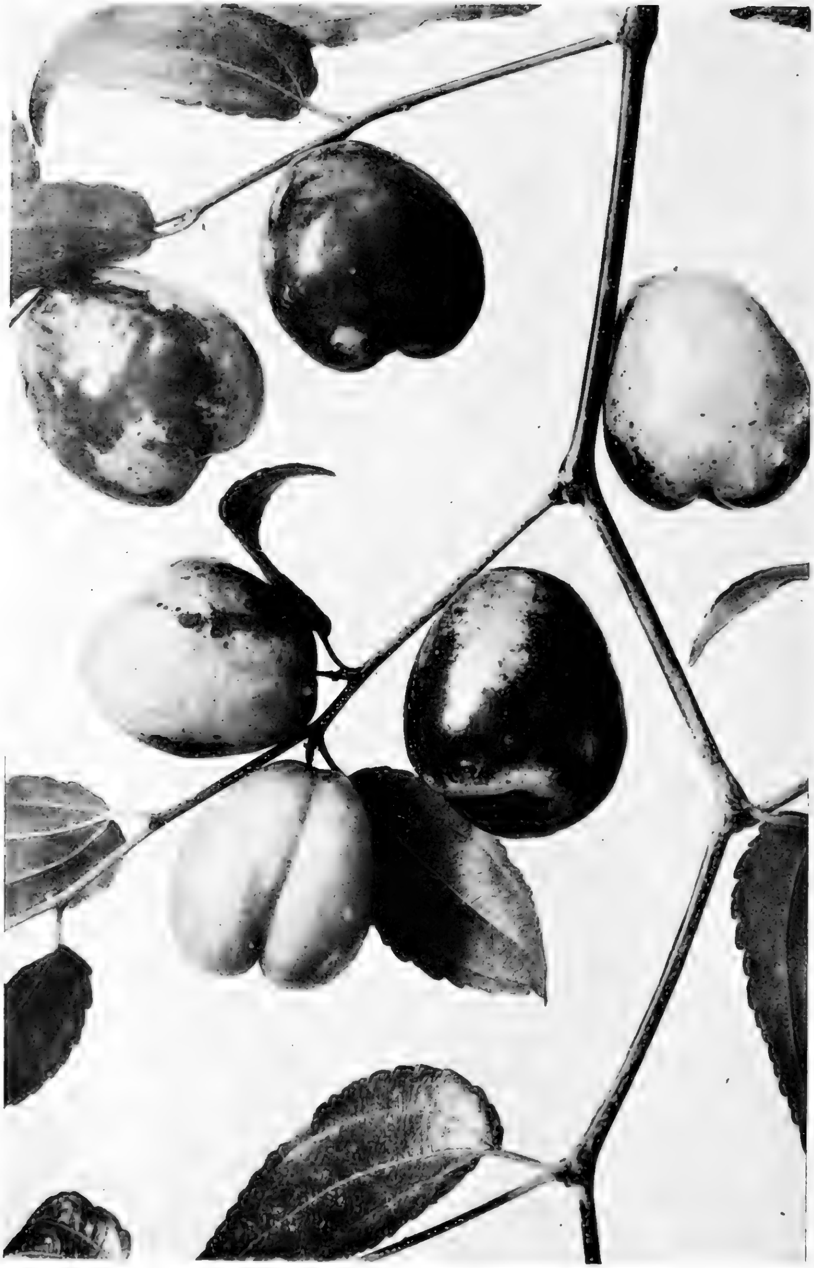
Although this variety of *Prunus serrulata*, S. P. I. No. 45051, is not so profuse a bloomer as many of the strictly double-flowered varieties, its large, almost white blossoms, which are often quite single, remind one in their beauty of single roses, and when scattered over the branches, of a large-sized tree, as they usually are, they produce when viewed from below, a most impressive sight. It is a late flowering variety, May 1 in Maryland. Photographed by Fairchild, twice natural size in order to emphasize the beauty of the flowers. (Fig. 8.)

THE JAPANESE MUME OR UME

As a spring-flowering tree, the Japanese apricot (*Prunus mume*) or Japanese plum, as the mume is incorrectly called, is perhaps the favorite of the Japanese poets even more than the flowering cherry. It often blooms so early that the snows fall on the fragrant blossoms. The fruits remind one of the American wild goose plum in flavor but are much better keepers. They are preserved and made into jelly and put down in salt while still green. These salted or pickled mumes are among the sourest pickles known and are excellent with meats. They form a part of the Japanese soldiers' ration, and are said to quench thirst on long marches. Many varieties of these mumes are recognized in Japan. The illustration is of fruits produced at Chico, Cal. Five-year-old trees have borne in Maryland also. Photographed natural size. (Fig. 9.)

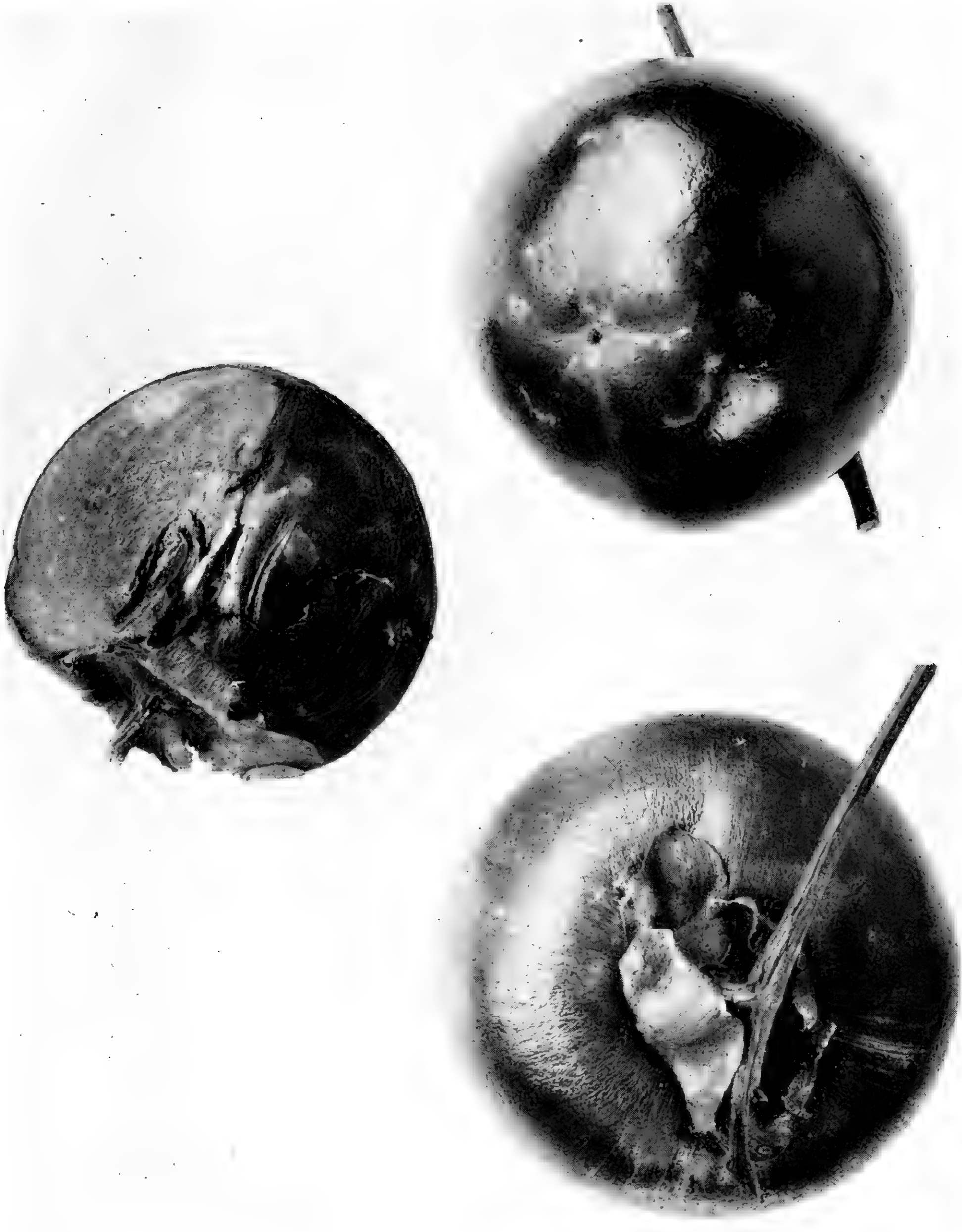
THE MU HSIN HUNG JUJUBE

An attractive medium-sized variety, S. P. I. No. 22684, collected by Frank N. Meyer at Tsintse, Shansi, China. Of good flavor and texture. The tree does not appear to be as heavy a bearer as smaller fruited varieties but it grows in China to a very large size with few side branches on the main limbs and has no spines. When processed the Jujube compares favorably with the date. Photographed natural size. (Fig. 10.)



THE CHINGCHOWFU JUJUBE

This variety, S. P. I. No. 30488, was introduced by the Rev. W. M. Hayes of Chingchowfu, China, and is said to be the largest variety of that region. The trees at Chico, Cal., have borne well and the quality of the fruits is excellent. Before ripening they are covered with brown blotches, which spread rapidly until the whole fruit is brown. As Mr. Hayes did not give the Chinese name for this variety the place name has been chosen. Photographed natural size. (Fig. 11).



A REMARKABLE PUCKERLESS PERSIMMON OF THE GOSHO CLASS

The greatest drawback to the persimmon has always been its astringency, which has made it necessary to ripen it until too soft to be eaten out of hand. This new variety which has first been fruited out in this country by H. Harold Hume of Glen St. Mary's, Fla., can be eaten while still as hard as an apple, and is then as delicious in flavor, and fine in texture, as the best of the soft varieties. It has a richer flavor than the Tamopan and appears to be more reliably tannin free, at least in Florida. S. P. I. 26773. Photographed three-fourths natural size. (Fig. 12.)

A NEW TYPE OF FRUITING CHERRY FROM CHINA

The Tanghsi cherry (*Prunus pseudocerasus*) S. P. I. 18587, orchards of which were shown to Mr. F. N. Meyer by the Rev. A. Kennedy, near the village of Tanghsi; in Chekiang province, has been identified as the true *Prunus pseudocerasus* of Lindley, under which name the Japanese flowering cherries have been commonly but erroneously known for seventy years. It appears that horticulturally, owing perhaps to the confusion in names, no attention has ever been given in America to this remarkable Chinese species of cherry. It turns out to be ten days earlier in fruiting than any other in northern California, and of sufficiently good quality without further improvement to attract commercial attention. The illustration shows a three-year-old bud on Mahaleb stock. (Fig. 13.)

AN INTERESTING STRAWBERRY PEDIGREE

THERE probably is no plant breeder who has not been much disappointed over the results of some particular cross which, from the history of the parents involved, had given every promise of fruitful returns; on the other hand it sometimes happens that parental varieties whose pedigrees seem to contain nothing of particular promise yield results of surprising value. A rather remarkable example of this appeared this year at the Experiment Station at Geneva, N. Y.

During the winter of 1889-90 C. E. Hunn, then acting horticulturist, pollinated the Johnson Late Strawberry with Sharpless. The female parent was a seedling of unknown origin sent to the station for test by a man named Johnson. Beyond being very late it did not prove of special promise and was soon discarded. Several seedlings were secured from this cross and these formed part of a lot of more than four hundred which fruited in 1893. The only one which eventually seemed worthy of retaining was one of these Johnson Late seedlings. This was named Hunn in honor of its originator. In 1898 Hunn was pollinated by Atlantic, a chance seedling from New Jersey of no remarkable value. The seedlings from this cross were grown in competition with about five hundred others and only one survived. This was named Quality. When Quality was grown in other localities it proved disappointing, and so was discarded, but not until seedlings of it were secured by self-pollination in 1907. None of these seedlings was found worthy of extended trial, but two of them, one perfect (with both stamens and pistils) and one imperfect (with pistils only), were retained in a study of sex. In this work the perfect was self-pollinated and the imperfect fertilized by the perfect. The resulting seedlings fruited for the first time this summer.

The seedlings of the selfed perfect were lacking in vigor, shy in yield, with small berries. The other seedlings obtained from the sister plant pollinated by this same perfect were one of the most remarkable collections that the station has obtained from a single strawberry cross. The plants were large and very vigorous and extremely productive with fruit above medium to large in size. Out of ninety seedlings in the cross twenty-four have been retained for further test—a proportion that has not been equalled by crosses involving some of the finest varieties under cultivation.

This is one of those cases which are the despair of the plant breeder because they seem to follow no law; but at the same time, if the breeder has something of the gambler's spirit and is willing to toss dice with nature, it is just such cases which encourage him to undertake work that otherwise would seem to have no justification save curiosity.

R. D. ANTHONY,
*Agricultural Experiment Station,
Geneva, N. Y.*

R. Ruggles Gates in British Military Service

R. Ruggles Gates, author of "The Mutation Factor in Evolution," who left the University of California last spring to enter the British Military Service, is now in the Royal Flying Corps. He is acting as instructor in machine gunnery at one of the aviation schools in England. His mail address is Care of University of London Club, 21 Gower Street, W. C., London.

MARRIAGE RATE OF NURSES

Less Than Half of the Graduates of the Best Training Schools Marry—Age Probably One Important Factor in This

THERE are in the United States nearly 200,000 women equipped to a greater or less extent to do nursing. About 79,000 of them are sufficiently trained to be registered. Physically the trained nurses represent a selection far above the average of the population, since only the physically superior can stand the strain; and mentally, too, they are probably well above the average. They represent, therefore, a desirable class eugenically, and it is important to know to what extent they marry.

Alumnae records of four of the larger training schools were examined from this point of view. The last class considered was 1901, since many of those who graduated since that date have still a possibility of marriage, while graduates prior to that time, being now more than 40 years old, are unlikely to marry, or if they did, bear children.

At the Massachusetts General Hospital, 560 graduates were listed. Eliminating fifty-six who died single, it was found that of the living, 213 or 42% are married.[1]

At the Johns Hopkins School for Nurses, 228 graduates were tabulated, of whom eleven had died single. Marriage was shown for 93, or 43%, of the living.[2]

At the Bellevue Training School for Nurses there was a record of 650 graduates,[3] 105 of whom had died single. The 185 who are married make a marriage-rate of 34%.

At the Training School of St. Luke's Hospital 201 had graduated and sixteen died single. Ninety-seven, or 52%, were reported as married.[4]

The variation from 34% to 52% in these complete married rates is considerable, and doubtless due to a very large number of causes. It was not possible to secure detailed class lists from other institutions, but five of the more important training schools courteously furnished such information as they had. Their data refer to all the graduates to date, and it is obvious that such figures are misleading, because the graduates of at least the last 10 years may still marry.

The Presbyterian Hospital in New York City states that its school of nursing has graduated 565 girls, of whom 163 have married. This makes a marriage rate (extremely incomplete, as noted above) of 29%.

At the Illinois Training School for Nurses (Chicago) 1314 graduates show 423 marriages, or 30%.

Of the sixty-two graduates of the Training School at Washington University (St. Louis) since 1908, thirteen or 21% have married.

The Presbyterian Hospital of Chicago has graduated 283 girls since 1906, of whom eighty-seven or 31% are married.

The University Hospital at Minneapolis is a young school; of its forty graduates only two have married.

In these five schools, it was not stated whether the total number of graduates given included those who are now dead; but presumably it did. Owing to the varying lengths of time involved, the rates given are not even comparable with each other.

BELLEVUE RATE LOW

It is interesting to compute the marriage rate of the graduates of Bellevue

[1] Massachusetts General Hospital (Boston) Training School for Nurses, Report for 1916. Classes of 1875–1901 inclusive.

[2] The Johns Hopkins Hospital (Baltimore) School for Nurses, circular of information, 1916-1917. Classes of 1891–1901.

[3] Forty-third annual report of the Bellevue Training School for Nurses, New York City, 1916. Classes of 1875–1901.

[4] St. Luke's Hospital (Chicago) Training School for Nurses, announcement, 1917. Classes of 1887–1901.

Training School on the same incomplete basis, since the complete rate has already been presented above (34%). The total number of graduates up to and including 1916 is 1,102. The annual report gives the following summary of their records:

Private nursing	283
Married	268
Institutional work	119
At home	148
Social work	58
Practising medicine	14
Deceased	139
Army	3
Unknown	30
Still in school	40
	1,102

Dividing the total, 1,102, into the number of married, 268, gives a marriage rate of 25%. Since the five schools whose rates were computed on this incomplete basis are little higher than 25% it is by no means certain that their complete rates will be much higher than the complete Bellevue rate (34%).

No amount of optimism can bring one to conclude that the marriage rate of trained nurses—or at least of the graduates of the best training schools—is even reasonably high.

WELL FITTED FOR MARRIAGE

On the whole, the education of a nurse fits her admirably for home-making and mothercraft. It might be supposed that such women would be in great demand as wives. The fact that they marry to such a small extent may indicate:

(*a*) That men do not use good judgment in selecting wives (this criticism has been heard more than once from graduates of women's colleges,) or that there is something in a nurse's education which men object to.

(*b*) That the nurses prefer to remain single. Many of them doubtless are set on a career, but evidently not all, for of the living, unmarried graduates of Bellevue, who have left school but whose whereabouts are known, 16% are not following their profession, but have apparently given it up and are living at home. It is doubtless true that nurses, having careers offering abundant employment and good pay, can be and are much more exacting in their requirements of a suitor, than are girls who have no future in sight except matrimony. Their celibacy can not be very largely due to lack of opportunities to meet men, for their opportunities in this respect are notably good. It may be that their work sometimes results in pessimism or cynicism with regard to men and marriage.

CAUSES NOT EASILY DEFINED

Any attempt to analyze the causes of this low marriage rate must be futile, until some data are available; for the factors involved are doubtless mostly complex psychological influences. But there is one simpler cause that may be suspected—age. Ten or 15 years ago, the age of admission to good training schools was from 21 to 25 years. The average age of girls at graduation was certainly not less than 25. The nurses who graduated from the four large schools cited at the beginning of this study, in classes prior to 1902, were therefore well toward the end of the most marriageable period in a woman's life, at the time of their graduation. Lately the age standards of training schools have been steadily reduced, twenty perhaps being an average minimum, although many schools will now admit pupils at the age of 19. The average age of graduates is therefore now about 23, according to those who are in a position to form an intelligent opinion. This decrease of age alone should tend to increase the marriage rate of the more recent graduates, as compared with those a decade or two ago.

The standards of selection of nurses are believed likewise to be changing, more girls taking up the profession in place of teaching school and similar occupations. This should mean a further increase in the marriage rate.

That such an increase is needed, in the interests of eugenics, will be generally recognized. It would be of much interest to know the birth rate among married nurses. Possibly some member of the American Genetic Association is in a position to investigate this.

BETTER HORSES

Industry Can be Rapidly Built Up in the United States by Elimination of the Inferior Stallion—Need of Horses in the War—Allies Have Taken Many, but Not the Best

IN SPITE of the fact that most of the cavalry troops in the world's armies have been dismounted and their dashing squadrons replaced by "tanks"; in spite of the fact that autos, tractors, and many other mechanical contrivances have been devised to replace the horse; nevertheless, the breeding of sound horses is of more importance to this nation today than ever before. The spavined, stringhalt, and ringboned horse is more than ever an undesirable member of the industrial forces, but the horse of good conformation and quality will steadily be in such demand that every sound animal will have a definite part to play both in war and in peace.

It is at such a time that the horse

A GRADE "TROTTING" STALLION

This animal was used from time to time for service in Wisconsin under the law prevailing there which permits the licensing of grade stallions for public service. So unsound and enfeebled that it would appear he would have difficulty in walking, it is hard to understand why he should be placed among the trotters. Popular choice, however, has demanded stallions of this breed and it is probably because of this popularity that the above veteran, who was palmed off on a new owner frequently, was included in this category, although to the experienced eye he presents many points in which he does not "favor" his supposed ancestry. Photograph from A. S. Alexander. (Fig. 14.)

HIS CHEAP FEE ATTRACTED MANY

Although mongrel-bred, unsound and with apparently no points to commend him to the prospective breeder, this horse enjoyed an extensive patronage, due to his cheap fee, although pure-bred stallions were maintained in his district and were equally accessible. It is reported that he has been retired from service. The present crisis demands that every similar unsound animal be likewise replaced by sound stock for breeding purposes. Photograph from A. S. Alexander. (Fig. 15.)

breeders of the country have an opportunity to contribute to the welfare of the country. Animals must be produced for much of the work on the battlefields, since horses can make headway over shell holes where an auto truck is unable to go; and the availability of the economic resources of the nation will be dependent to a large degree on the accessibility of sufficient draft animals.

During the past three years, the Allies have not only utilized their own equine resources but have also made heavy drafts on American stock. Up to May 1, 1917, the entente had imported from this country 1,107,152 horses and mules, at prices ranging from $100 to $250, Since the number of horses in the United States is approximately 24,100,000, about 4.0% of the available horses have been purchased and about 6.0% of the available mules.

ALLIES DID NOT GET THE BEST

It has often been stated that the Allies have stripped the American market of all superior horses, so that few are left except those physically unfit for war work. Such is not the case. Data compiled by the Bureau of Animal Industry, U. S. Department of Agriculture, indicate that the Allies have purchased only average horses from the sound stock of the country and that facilities for breeding good stock are just as available as ever. There is certainly enough good stock in the country which is accessible to the breeder for producing the essential animals for use during the

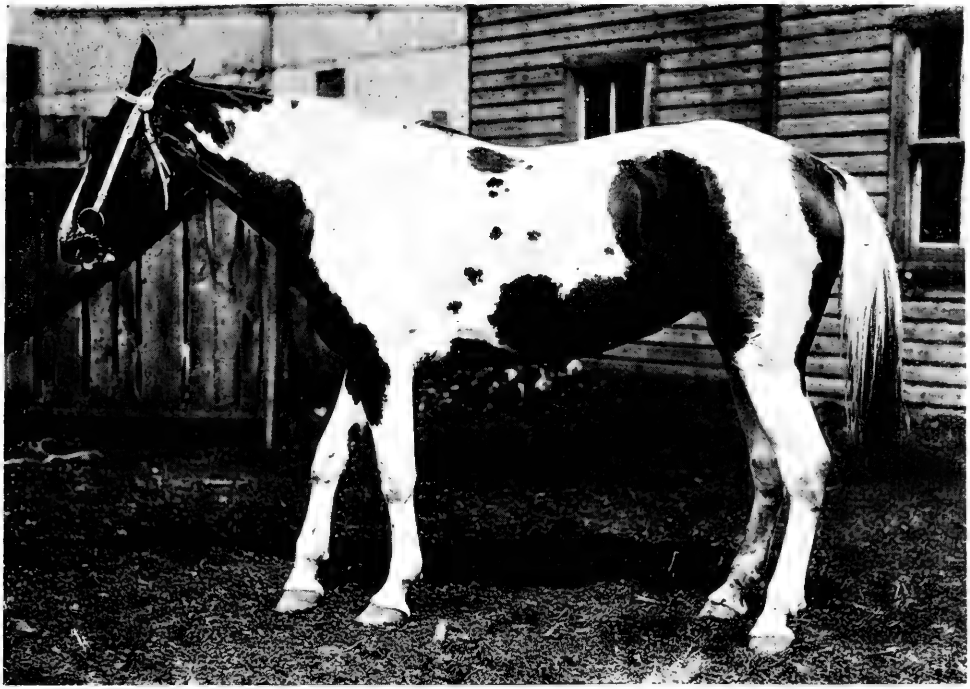
AN OBJECTIONABLE AND UNSOUND STALLION

The spots and undesirable conformation of the hind leg are the two most noticeable features of this stallion, who was supposed by the miraculous virtue of a tincture of pure blood somewhere in his ancestry to be able to stamp his offspring with the desirable traits of the breed with which he was supposed to be connected. As shown by the following two pictures, he proved to be as prepotent as the most optimistic had hoped, but not in quite the manner they had anticipated. Photograph from Bureau of Animal Industry. (Fig. 16.)

war and during the vast economic reconstruction which will follow, but there are also far too many unsound and mongrel animals which will be a drag on the industry as long as they are used for breeding. These ill-bred animals should be eliminated. The most important measure in this connection is to eliminate inferior stallions, since one stallion may transmit faults to the offspring of hundreds of mares.

The work of stallion licensing was first taken up in Wisconsin, where the method of operation can be advantageously studied. Although it may not seem at first sight that the mere act of licensing stallions would form a panacea for all breeding troubles, and turn out the perfect horses which are so essential in the scheme of war preparedness, nevertheless, it will be found upon further investigation that the license laws have played an important part in eliminating scrub sires.

In Europe, almost ideal breeding laws have prevailed for a long time. The French Government has for over a hundred years maintained stables of selected pure-bred stallions, and the owners of superior horses receive a bonus for keeping them in the country for service. In Belgium, the government used to spend large sums of money annually in prizes and appropriations to encourage horse breeding along the right lines. Similar conditions prevail in Germany, where prizes are offered for brood mares and stallions of unusual worth. Austria, England, and Scotland all have similar methods of encouraging prudent breeding and the results are self-evidently well worth the time



WHAT THE SPOTTED STALLION PRODUCED

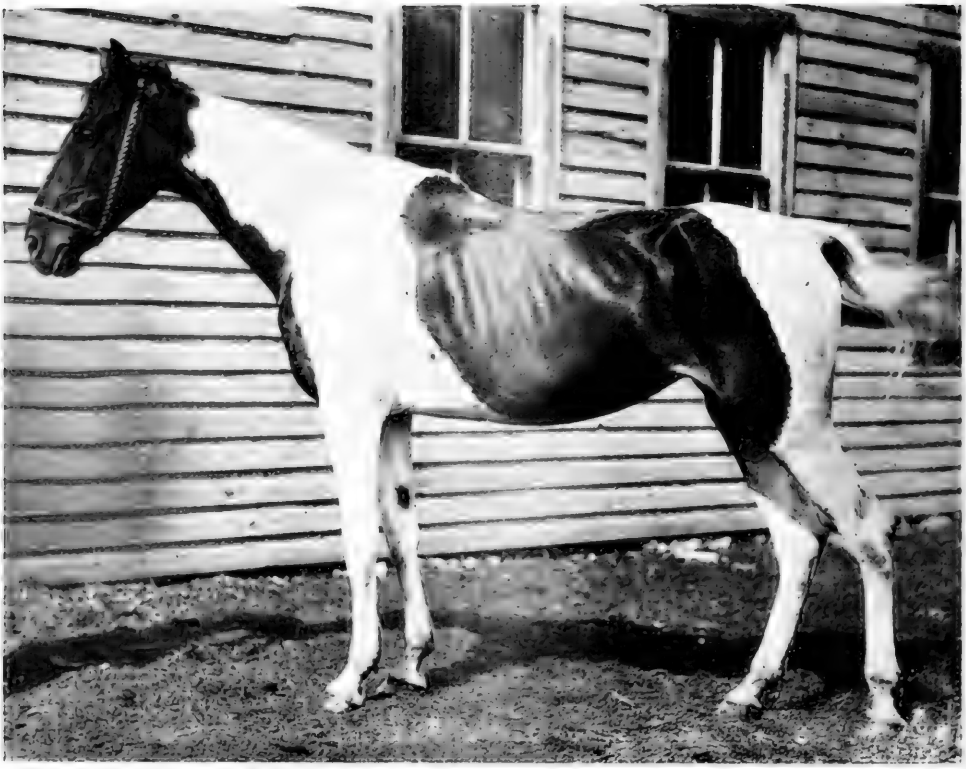
This mare was sired by the stallion shown in the preceding figure, and the curby conformation of the left hind leg is plainly noticeable. The piebald pattern itself, which is always transmitted by a stallion who possesses it to at least half his offspring, is no more conspicuous to a horseman than the inherited leg-conformation. Photograph from Bureau of Animal Industry. (Fig. 17.)

and money which has been spent in achieving them.

The progeny of a grade stallion from a mongrel mare is usually inferior in every way. The main reason for this is that the grade horse has not the prepotency to stamp the characteristics of the pure breed upon his offspring. One infusion of pure blood may be sufficient to make the first generation resemble markedly a given breed, but in the second generation, and often in the first, there is an overwhelming tendency for the large mass of mongrel ancestry to crop out, and hence the offspring may in no way resemble the breed which it is supposed to represent. When a pure-bred stallion is used, he is generally prepotent enough to stamp his offspring with the desired qualities, but the offspring when again bred with mongrel stock is rarely prepotent enough again to bring forth the desirable traits.

The only way by which the horse industry can be built up in this country along right lines is by grading. But this grading must be carried on by right methods, and should not include the use of grade stallions. It is obviously impossible to depend wholly on pure-bred stock, because only a small percentage of the animals in this country are pure-bred. This is especially true of brood mares, which, producing only one foal a year, would have to be available in enormous numbers in order to obviate the necessity of using mongrel or grade mares. Hence, it is easily evident that the grading system offers the only solution of the problem of building up the breed on the maternal side.

But on the paternal side the case is quite different. Since one stallion can serve successfully a hundred or more mares in one season, a comparatively



ANOTHER MARE FROM THE SAME STALLION

This mare might possibly be placed in the much-abused "general purpose" class, but she inherits the crooked hind legs of her sire, together with many of his other defects, and hence is of little real value. Photograph from Bureau of Animal Industry. (Fig. 18.)

small number of pure-bred stallions will suffice to carry on the grading-up process satisfactorily. The use of grade mares because of the non-availability of pure-breds is hence logical and satisfactory in the grading system, but the use of other than pure-bred stallions is inexcusable.

In work which was started some time ago by the Bureau of Animal Industry, pure-bred stallions of unusual worth were stationed in various districts, and service was furnished to owners of mares gratis. In return for the free service, the government obtained an option on the colt during its third year at a price of $150, or if the farmer wished to dispose of it elsewhere, he could be released from his contract by paying $25 as a service fee. Due to small appropriations for this work, it has not yet attained such proportions that a definit report on its success can be made.

Horses will be needed on the battlefield and on the farm; to haul the cannon and the plow. Good horses which can stand up under the demands of the economic crisis of the country can be produced just as cheaply as unfit animals with ewe necks, waspy waists, cat hams and starey coats. The cheap service fee will be lost in insignificance compared with the relative prices which will be paid for sound and unfit for horses; In the great agricultural preparedness of the country, the breeder of sound and fit horses has just as responsible a position as any "soldier the commissary." It is his duty to fulfil that responsibility by turning out through prudent breeding and by avoiding inferior stock as has been described, horses which can "do their bit."

INHERITANCE OF A BI-LOBED EAR

Richard Schofield

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IN a family in which a bi-lobed ear has been transmitted through four generations, only the right ear shows the characteristic in question. The line of separation does not parallel the vertical axis of the body, but tends to follow the posterior margin of the ear. There is no regularity in its manifestation so far as generations are concerned, and it appears in either sex, and in both sexes in the same family. Its appearance is not constant, for it may skip one or even two generations and then be present.

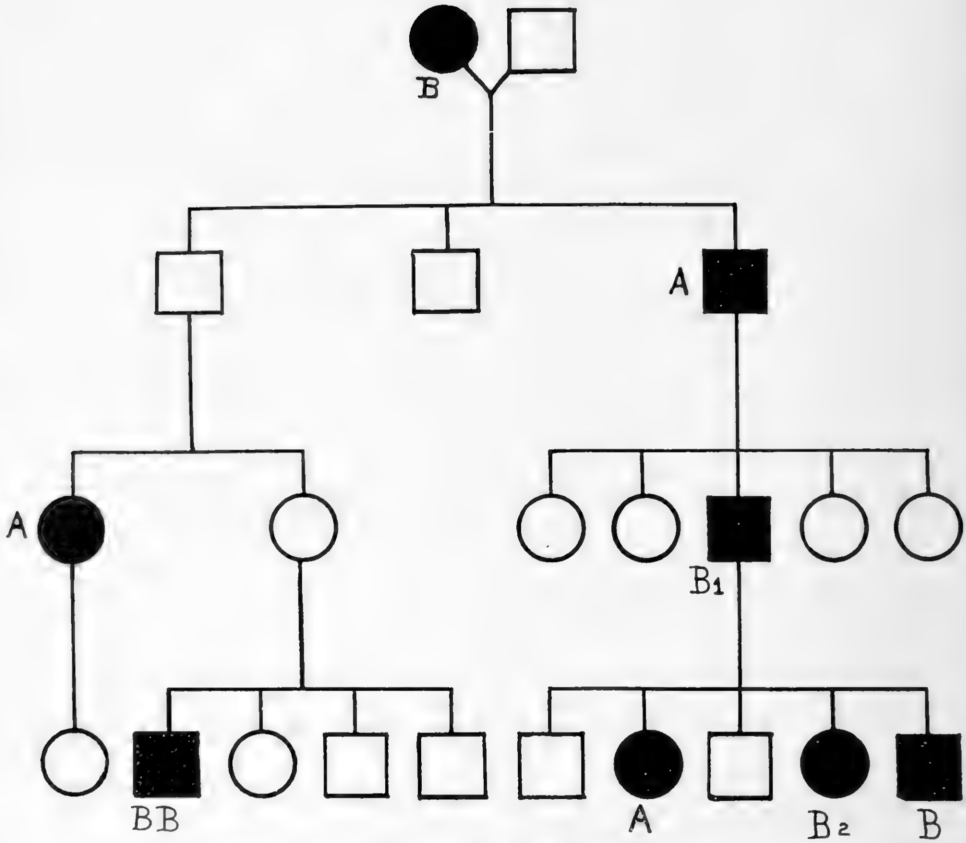
In the individuals designated in the chart by A there is a very marked deep cleft that is of considerable length, while in those marked by B the cleft is not so well marked, and in the case designated by BB it is so slight as to be nothing more than a furrow. In the individuals B1 and B2 there is a deficiency in hearing in the bi-lobed ear, while in the others there is no apparent deficiency of any kind. No information is obtainable as to when this strange anomaly was first noticed in the family, but in each individual affected the trait is as pronounced at birth as at any other time, and it does not increase with the age of the person. Each case charted has been seen by the writer except the female shown in the first generation. The cleft probably originated as a mutation, though nothing definite can be said in this regard; and from its mode of transmission it appears to be an imperfectly dominant trait.

In the Journal of Heredity, December, 1916, there appeared an article by A. E. Jenks, "Pitted Ear Lobes of Congenital Origin," in which a condition is described similar to the present case. The author evidently thinks that there is at least a possibility of the trait being the result of a mutation which first appeared three generations previous to the one he has described. The character, like the present one, appears to be transmitted as an imperfect dominant.

In the case at hand there is exhibited a variable inheritance which ranges from the deep cleft in one instance to the slight furrow in another individual. The imperfection of dominance may well be explained by the variability of the potency of determiners, or perhaps as the result of environmental factors.

OUTLINE OF EAR

Although every individual affected did not present quite the same characteristics, the above drawing shows graphically the striking division of the lobe. (Fig. 19.)



INHERITANCE CHART OF BI-LOBED EAR

The squares represent males, the circles females, affected individuals being designated in black. As may be seen, both sexes appear to be affected equally and indifferently. (Fig. 20.)

A Study of Bud Variations in Coleus

One of the most valuable recent contributions to the study of evolution is that of A. B. Stout, director of the laboratories of the New York Botanic Gardens (Carnegie Inst. Washington Pub. 218). He started with a single variety of Coleus, an ornamental plant much used for bedding and in pots for indoor display. This was propagated by cuttings and showed both gradual fluctuations and abrupt mutations, sixteen distinct and characteristically different color patterns being eventually produced. The results are interpreted by Dr. Stout to mean that slight variations, arising either suddenly or gradually, can perpetuate themselves, as Darwin supposed but as some recent biologists have denied. It is claimed that bud mutations in Coleus are common, result in numerous different types which may be vegetatively constant from the first or can be made so by selection, show development of certain types more commonly than others, produce reversions to parental types, give development of different degrees of variability among sister clons, and exhibit spontaneous changes in the fundamental color patterns and in the cellular and tissue patterns resulting in color patterns. Sexual and asexual reproduction are therefore believed to be not fundamentally different in respect to extent and range of variation.

THE HAIRLESS DOG

FEW breeds of dog have received less attention from breeders than the hairless dog of Northern Mexico, sometimes called the Chihuahua dog. It is presumably descended from one of the Central American wolves. Fitzinger[1] considered it a distinct species, but without much evidence. The breed is comparatively rare even in Mexico.

The hairless condition is strictly an abnormal one, and is said to be associated with defective teeth. The dogs are extremely sensitive to changes of temperature, as well as to flies. To the touch they feel very warm, which may account for their reputation in Mexico for curing rheumatism.

The accompanying photographs are furnished by Arthur Stockdale of Mexico City, who writes that hairless dogs breed readily with normal dogs, and that half of the offspring are haired, half hairless. The sharp contrast between the two pups shown in the photograph indicates that the hairless condition may be a unit difference.

Fig. 1 shows the mother, a typical hairless dog. In Fig. 2 are two of her pups, litter brothers, sired by a mongrel dog who was normally haired.

A MEXICAN HAIRLESS DOG

This bitch, presenting all the typical characteristics of the hairless breed, was bred to a normal haired dog. Her pups are shown in the following picture. (Fig. 21.)

[1] Fitzinger, L. J. Untersuchungen über die Abstammung des Hundes. *Sitzungsber, math.-nat. cl. K. Akad. Wiss.* liv., pp. 396–457. Wien, 1866. See also the same author, *ibid*, lvi, pp. 494–9, Die Rassen des zahmen Hundes.

HAIRLESS AND HAIRY PUPPIES FROM THE SAME LITTER

The pup on the left presents no similarity to the hairless breed, while the one on the right has every characteristic of the typical hairless dog. This would seem to indicate that hairlessness is a unit characteristic. (Fig. 22.)

A Handbook of Mendelism for Live-stock Breeders

DIE BEDEUTUNG DES MENDELISMUS FUR DIE LANDWIRTSCHAFTLICHE TIERZUCHT, von J. H. W. Th. Reimers. Pp. 105. 'S-Gravenhage, Martinus Nijhoff. 1916.

No clearer and sounder discussion of the application of Mendelism in animal-breeding exists than this booklet of Professor Reimers, editor of the *Veldpost*, the greatest agricultural journal of Holland, and instructor in the agricultural school at Utrecht. After a full explanation of the Mendelian laws, he discusses their limitations, fully recognizing that they are not of great importance so far to the practical breeder. He then outlines a method of selection on the basis of the animals' performance as breeders, which is in accord with the theory of genetics.

COLOR INHERITANCE IN MAMMALS

VI, Cattle—Explanation of Reds, Roans, Whites in Short-horns Long a Matter of Dispute—Analysis Shows That Only a Single Pair of Mendelian Factors Can Be Involved aside from Minor Variations—Colors in General Determined by Combination of Independent Sets of Allelomorphs and not by Polygamous Factors—Dun the Dilute Form of Black

SEWALL WRIGHT

Bureau of Animal Industry, Washington, D. C.

BLACK COW—WVDME

$1a_1$	W, w	Ww—roan, WW—white
$1a_2$	V, v	V—pied
$1a_3$	—	
1b	D, d	D—dun
	M, m	eeMM—mahogany (sex limited).
$1a_1$	—	
$2a_2$	E, e	ee—red
$2a_3$	—	Unanalyzed factors for brindle.
2b	—	

FACTOR COMBINATIONS

	ww	Ww	WW
DE....	dun	dun roan	white(dun ears)
Dee ...	yellow	yellow roan	white(yellow ears)
ddE ...	black	blue roan	white(black ears)
ddee ...	red	red roan	white(red ears)

Classification explained in paper on the Mouse, JOURNAL OF HEREDITY, 8:373. August, 1917.

THE first colors in cattle to receive attention from geneticists were the whites, roans and reds of Shorthorns. Barrington and Pearson[1] made a study of Shorthorn herdbooks in 1906 with conclusions adverse to Mendelian inheritance. Wilson,[2] however, soon pointed out how closely the general facts fitted with the hypothesis that roan is the heterozygote between red and white. Since then many investigations have been made on the question with essentially similar results. There is a general harmony with unit factor inheritance, but also a small per cent of well authenticated discrepancies with theory, even after allowing for the known inaccuracy of herd books. The summary by Wentworth[3] given at the bottom of this page illustrates the case well. The last column gives the expected number of young from each kind of mating, if mating were wholly random as regards color.

UNIT, NOT MULTIPLE FACTORS

Various multiple factor hypotheses have been devise to meet the situation. Laughlin[4] advanced an hypothesis involving four pairs of factors and two physiologically distinct groups of hairs scattered over the body. By this means any particular case that might

	Red	*Roan*	*White*	*Total*	*Expected*
Red × red	1,710	102	39	1,851	1,998
Red × roan	1,763	1,336	15	3,114	3,620
Red × white	20	891	18	929	724
Roan × roan	664	1275	471	2,410	1,642
Roan × white	8	168	72	248	657
White × white	4	8	141	153	64
	4,169	3,780	756	8,705	8,705
	47.9%	43.4%	8.7%		

[1] Pearson, K. and Barrington, A. 1906. *Biom.*, 4:427.
[2] Wilson, J. 1908. *Sci. Proc. Roy. Dub. Soc.*, 11.
[3] Wentworth, E. N. 1913. *Amer. Breed. Mag.*, 4: 202–208.
[4] Laughlin, H. H. 1912. *Amer. Nat.* 45:705.

arise could be explained. Unfortunately the general facts become inexplicable on this view. Wentworth advanced a more easily tested hypothesis; viz., that there are separate factors for roan and white. Factor P for roan is considered dominant over p for red and factor R for color is dominant over r for white.

	PP	Pp	pp
RR........	roan	roan	red
Rr.........	roan	roan	red
rr.........	white	white	white

This view also, however, may be shown to account for the discrepancies from the simple one-factor hypothesis at the expense of the general facts. An analysis of Wentworth's data on the assumption that cattle breeders pay little attention to color gives some interesting results. From comparison of the total number of young from each kind of mating in the data above with the number expected on random mating (column "expected") the degree to which mating is preferential in regard to color may be estimated. The expected number of young from each kind of mating has been calculated on the assumption that the Shorthorn population is in equilibrium as regards color and that matings actually are by chance in this respect. Thus with 47.9% of the animals red, .479 × .479 of the matings should be red by red giving an expected number of calves of 1998, where the actual number was 1851. The table indicates a distinct excess of matings of roan by roan and white by white. Roan by white and roan by red seem to be most discriminated against. On the whole the assumption of random mating should give sufficiently accurate results for the present purpose.

Red is rather more common than roan which means that factor p is more common than P. Thus most whites should be of formula pprr or Pprr and very few PPrr in a population breeding at random. Thus whites crossed with reds (pp) should produce more reds than roans which is very far from the case. On the basis of equilibrium, it is easy to calculate the expected proportions of each genetic formula in the population and hence the proportion of each color of young in any cross. The per cent of whites (rr) is 8.7. The relative proportions of heterozygous and homozygous colored (Rr and RR) must be such that the number of heterozygotes is twice the product of the square roots of the number of the two homozygous classes by the well-known formula for a Mendelian population in equilibrium. This gives 41.6% heterozygous colored and 49.7% homozygous colored. By excluding from consideration the whites, in which the distinction between roan and red is considered to be hidden, the per cents of homozygous roans, heterozygous roans and reds can be calculated in a similar manner. By multiplying together these two sets of calculations, the per cents of each of the nine combinations of factors can be found. Thus with 49.7% homozygous colored (RR) and 40.0% heterozygous roan (Pp), the product, 19.9%, is the proportion of roans of formula RRPp. The tables below summarize the results:

Formula	%	
RR	49.7	70.5%—per cent of R's in the population.
Rr	41.6	29.5%—per cent of r's in the population.
rr	8.7	
	100.0	
PP	7.6	27.6%—per cent of P's in the population.
Pp	40.0	72.4%—per cent of p's in the population.
pp	52.4	
	100.0	

PER CENT OF FACTOR COMBINATIONS

	PP	Pp	pp	
RR.....	3.8	19.9	26.1	49.8
Rr......	3.2	16.6	21.8	41.6
rr.......	0.7	3.5	4.6	8.8
	7.7	40.0	52.5	100.2

From these data we can make up all kinds of matings and calculate the per cent of each color, which should be produced. The matings red by white and roan by roan are most significant. Allowing for the proportion of the four kinds of roans, two kinds of reds and

three kinds of whites, the following per cents of red, roan and white offspring are expected. The percentages expected in the simple one factor hypotheses that roan is the heterozygote between red and white are also given and finally, the per cents actually found as given in Wentworth's data quoted above.

Parents red × white	% Red	% Roan	% White
By two factor hypothesis.	55.9	21.3	22.8
By one factor hypothesis.	0.0	100.0	0.0
Actually found........	2.2	95.9	1.9

Parents roan × roan	% Red	% Roan	% White
By two factor hypothesis.	16.7	78.1	5.2
By one factor hypothesis.	25.0	50.0	25.0
Actually found........	26.6	52.9	19.5

The striking fact that in a population breeding nearly at random, roan by roan produces little more than 50% roan, the rest being divided between red and white, while red by white produces about 96% roan, can hardly be accounted for on any theory of inheritance other than a single main Mendelian factor without dominance. The exceptions must be accounted for on hypotheses subsidiary to this, as is done by Wilson and by Walther.[5] The two factor hypothesis gives expectations far removed from the actual results and the writer can devise no other hypothesis involving multiple factors of anything like equal influence which is appreciably better. Finally, an additional test may be noted which the one factor hypothesis meets quite successfully. With 756 whites (WW) and 4,169 reds (ww) in a population in which there is random mating, the number of roans (Ww) should be twice the square root of the product, or 3,551. The actual number 3,780 is as close as can be expected, considering the departures from random mating in the present data.

VARIATIONS OF ROAN

As for the discrepancies, part are known to be due to errors in the herd books. A clue to the remainder is seen in a consideration of other breeds which show the nearly solid white condition.

An excellent review of the subject has recently been written by Lloyd-Jones and Evvard.[6] The famous Chillingham cattle are white with dark points. They occasionally throw black or dun colored calves. Here white is clearly dominant. A very similar white with dark points crops out from time to time in Pembroke and in Highland cattle, although constantly selected against. Here as Lloyd-Jones and Evvard point out white is clearly recessive. Thus we have whites of very similar appearance which are respectively recessive, dominant or neither in Pembroke, Park cattle and Shorthorns. Is it necessary to suppose that three independent factors are involved? The simplest explanation seems to be that there is a continuous series of physiological conditions between a very strong self tendency through roan to a very strong white tendency. The level in this series possessed by a particular group of epidermal cells of any animal is determined perhaps by many factors, some merely developmental (making it possible for adjacent hairs to have different potencies and so produce the roan effect) and some hereditary. Among the hereditary factors, two hypotheses are at present equally possible. There may be one Mendelian pair (W,w of this paper) which stands out in the importance of the effect but which, nevertheless, cooperates with lesser factors which determine the general level in the series; or there may be a series of allelomorphs such that a more potent white factor is dominant over a self factor which is just below the roan level and *vice versa*. The two hypotheses would give very different results but there seem to be no data at present by which they may be distinguished.

This roan factor quite certainly belongs in class $1a_1$ in spite of its variable dominance. It is a factor which determines an inhibitor of color regardless of the quality of the color. The truth of

[5] Walther, Ad. 1913. *Zeit. f. Abst. u. Ver.*, 10:1–48.
[6] Lloyd-Jones O. and Evvard. 1916. *Res. Bull. No.* 30, *Ag. Exp. Sta.*, Iowa State Coll. Agr.

this statement is at once apparent on considering the results of crossing Shorthorns which are white with red points with self black Galloways or Angus cattle. These very common crosses produce blue roan calves. The white pattern is the same as in Shorthorn roans though the color is changed.

As to the genetic relations between black, red and white, two views are held. Wilson[7] has argued that black, red and white as well as most other cattle colors belong to the same series of allelomorphs or "polygamous factors." His scheme is as follows:

BB —black		
BR —black	RR —red	
BW—blue roan	RW—red roan	WW—white

On this hypothesis no blue roan (BW) should be able to transmit red. This should be possible on the hypothesis of independent factors as given under "Factor Combination" at the head of this article. Lloyd-Jones and Evvard report on the cross of white and red roan Shorthorns with black Galloways. F_1 consisted mainly of blue roans (from white sire) or blue roan and blacks (from red roan sire). The blue roans in F_1 must be BW on Wilson's hypothesis, EeWw on the hypothesis of independence. In F_2, twenty-six calves were obtained of which six were reds of some sort (four solid red, one red and white, one red roan). This result obtained under experimental conditions seems thoroughly sufficient to establish the hypothesis of independence, and even the absence of appreciable coupling between E and W. Furthermore, the production of whites with black ears and muzzles (presumably EeWW) but which on Wilson's hypothesis must be identical in formula with the red-eared white ancestor is pretty conclusive as to independence of the white pattern and the quality of the pigment it inhibits.

PIEBALD PATTERNS

Piebald patterns, running from a bit of white on the switch or underline as in some Galloways to a nearly black-eyed white condition as in some Ayrshires, are very common in cattle. It is generally agreed that this white is inherited independently of the character of the ground color and can be transmitted from a red breed to a black one and *vice versa*. The white-faced black calves that result from crossing the white-faced red Herefords with the solid black Angus are familiar examples. Boyd[8] has shown that Hereford by bison produces white-faced hybrids usually black or dark brindle. As regards the mode of inheritance, however, there is little which can be considered established. The cross cited above indicates at least partial dominance but, of course, does not prove unit Mendelian inheritance. In Shorthorns, neither Wilson nor Wentworth could find any simple mode of inheritance, solid red by solid red might produce red and white piebalds and *vice versa*. Lang[9] cites crosses made by Kiesel in which the self colored Limburger race was crossed with a piebald German breed. F_1 was intermediate piebald. The back cross with the self breed produced 22 self, 29 piebald. The back cross with the piebald race produced 84 out of 90 piebald. The case is probably similar to that of piebald in most other mammals, heterozygote intermediate and much variation which is not genetic.

One of the most interesting things in connection with the pied cattle is the number of sharply distinct patterns which have become fixed. There is the white face of the Hereford, the white belt of the Dutch and the irregular pied pattern of Holsteins, Ayrshires and other breeds. Are these to be looked upon as entirely independent of each other genetically and physiologically or have they a common element? In guinea-pigs all of these patterns and many others may crop out even in the same litter in a stock in which the total amount of white is relatively constant. MacCurdy and Castle[10] have shown, however, that a tendency toward one

[7] Wilson, J. 1916. A Manual of Mendelism. 152 pp.
[8] Boyd, M. M. 1908. *Amer. Breed Ass. Rep.*, 4:324–331.
[9] Lang, A. 1914. *Experimentelle Verebungslehre*, 467–888.
[10] MacCurdy, H. and Castle, W. E. 1907. *Carn. Inst. Wash. Pub.* 70, 50 pp.

type of pattern can be produced by selection. The conditions strongly suggest that the pattern is the resultant of two very different kinds of factors, factors which determine a certain general level of some essential for pigment production and factors which affect the course of development so as to bring out particular lines of weakness in which the pattern of white shall appear if the general level is low enough. On this view a Hereford, a Dutch-belted cow and a Holstein might possess the identical piebald factor as regards quantity but differ in hereditary factors which determine the type of regional differentiation. As far as the writer knows no Mendelian differences of this second kind yet have been demonstrated in any mammal.

Spillman[11] early showed that red is a simple recessive to black. Red calves appear from time to time in purebred Angus and Galloway cattle which are nearly fixed for black. In crosses discussed by Jones and Evvard, red Shorthorn by black Galloway produced black in F_1 with a few exceptions, while red segregated out in the expected ratio in F_2.

INTERGRADES BETWEEN BLACK AND RED

Several types of apparent intergrades between red or yellow and black are known. These are the brindles, duns and dark mahogany browns. In the brindles, however, there may be any ground color according to Wilson, red, yellow, dun or even black. The brindling consists in irregular streaks of black (or especially dense black if the ground color is black). In duns the coat is largely of a dull brownish black, the hairs showing a yellowish tip and the yellow color tending to predominate especially along the mid-dorsal line. The mahogany brown as in some Ayrshires may look almost black but appears to be simply a very intense red.

The most extensive investigation of brindle and dun has been made by Wilson[12] in a study of Highland herd books. Black, dun, brown, red, yellow, light dun and brindles are recorded. Occasionally whites appear as has been discussed. The palest yellows appear to be registered as light duns although free from the black of the true duns. As has been noted, Wilson explained the results by a system of multiple allelomorphs. He considers each of factors B, R, L, Br and W to be a Mendelian alternative of any other:

BB black				
BR black	RR red			
BL dun	RL yellow	LL light dun		
RBr dark brindle	BBr red brindle	LBr dun brindle	BrBr brown	
BW blue roan	RW red roan	LW	BrW	WW white

Reasons have already been given for separating the factor for white from this series, as far as black and red are concerned. As regards brindle, the very fact that it can be visibly combined with any color suggests that it is as independent in inheritance as piebald. Brindle evidently means so many different things in Highland cattle that little can be learned from the data. In Wilson's tables brindle by brindle produces only about 50% brindles which may perhaps be taken as indicating its usual heterozygous nature. Brindle by red gives only about 23% brindles, 67% reds and a few others which shows that it cannot be due to a simple dominant if it is recorded at all accurately. The larger part of the brindles have at least one brindle parent but this is far from invariable. On the whole brindle can better be fitted as dominant than recessive but further study is necessary before any form of Mendelian inheritance can be considered established. For the present it seems safest to separate brindle from the other factors, as due to unanalyzed factors of class $2a_3$ which determine an increase in the density of black in irregular streaks on any ground. The fact that brindle by red gives only 4% black shows that brindle in the records generally means red brindle as might be expected and that factor e, not E, is present. Probably black brindles are usually simply called black.

[11] Spillman, W. J. 1907. *Sci. N. S.*, 23:545.
[12] Wilson, J. 1909. *Sci. Proc. Roy. Dub. Soc.*, 12–66.

More definite conclusions can be reached in regard to dun. The following table, which is a slight modification of Wilson's table for herd book 2 of the Highland cattle, shows some very interesting points. The progeny of each color are tabulated by per cent of the total, the total numbers being given in the last column for reference.

		Black	*Dun*	*Red*	*Yellow*	*Brindle*	*Number*
Black	× black	71	5	18	1	5	97
	× dun	29	45	11	13	1	82
	× red	43	4	43	4	7	239
	× yellow	27	24	16	29	3	74
	× brindle	45	2	29	2	22	181
Dun	× dun	(6)	0	0	(6)	(88)	(16)
	× red	18	13	23	46	0	54
	× yellow	2	53	11	30	5	64
	× brindle	18	32	9	18	22	87
Red	× red	3	1	86	9	2	131
	× yellow	5	2	46	35	12	121
	× brindle	4	0	67	6	23	188
Yellow	× yellow	5	2	46	35	12	73
	× brindle	3	4	22	49	23	111
Brindle	× brindle	13	0	35	2	50	80

A consideration of this table certainly justifies Wilson's contention that duns contain the factor by which blacks differ from reds. The crosses involving only red, yellow and brindle produce very few blacks and duns, probably no more than can be accounted for by errors in the records. The cross of black with black produces 71% blacks, not much below the 75% expected if blacks are heterozygous (Ee) which should generally be the case in Highland cattle. Black by red or brindle produces but little less than the expected 50%. But in the crosses of black by dun or yellow only 29% and 27% black calves are produced which shows clearly that factor E must be present in some other color than black. This color can only be dun (except perhaps for an occasional black brindle). Combining blacks and duns as mostly of formula Ee and reds, yellow, and brindles as mostly ee, the agreement between figures and expectation becomes fairly good.

It is further evident from the table that dun and yellow are closely related in some way. Black by yellow produces many duns (24%) and dun by red produces many yellows (46%) while neither color is produced in reliable numbers unless at least one parent is either dun or yellow. Wilson explains this by assuming that dun and yellow are respectively the heterozygotes of black and red with the rather uncommon cream-colored light dun which he puts in the same series as black and red. As an alternative hypothesis we may suppose that dun and yellow differ from black and red respectively by an independent dominant dilution factor of class 1b.

(1) Triple allelomorphs

BB black		
BR black	RR red	
BL dun	RL yellow	LL light dun

(2) Two factor hypothesis

	DD	Dd	dd
EE	...cream dun	dun	black
Ee	....cream dun	dun	black
ee	....cream (light dun)	yellow	red

Probably the best criterion between the two hypotheses which is present in the data is in the results of the cross dun by red. On Wilson's view (1) this should produce only blacks and yellows (BL × RR = BR + RL). On hypothesis (2), duns, blacks, yellows and reds should all be produced (EeDd×eedd= EeDd+Eedd+eeDd+eedd). The results, 7 duns, 10 blacks, 25 yellows and 12 reds point strongly toward the hypothesis of independence, although the excess of yellows and reds indicates that some of the parents called duns were probably really yellows lacking factor E. The color called light dun appears generally to be extreme dilution of red. It produces very few blacks and duns unless crossed with these varieties. The evidence for a unit Mendelian difference between red and light dun with yellow as the heterozygote is not as clear cut as could be

wished but the same considerations which apply in the case of roan shorthorns apply here. Yellow by yellow seems to produce distinctly fewer yellows than does red by light dun. No doubt subsidiary factors must be assumed to produce overlapping of class ranges. Following are some figures given by Wilson. The yellow by yellow data are from herdbooks 13, 14, 15; the red by light dun from books 3 and 15.

	Red	*Brindle*	*Yellow*	*Light dun*	*Dun*	*Black*
Yellow by yellow	15	5	40	8	5	1
Red by light dun	4	0	25	3	1	1

The factor D by which dun and yellow differ from black and red respectively fits best into class 1b and may be compared with the dun factor of horses. Dun cattle it is true appear to differ from blacks not only by dilution of color but by increase in yellow, but even blacks often show a red rustiness at the tip of the hair which suggests that they have been selected from a type with a pattern comparable to the agouti of rodents. In the general dilution of color brought about by factor D, the reduction in density of black permits the agouti pattern to become more visible. There is probably no color in cattle which can be compared with the recessive blacks among rodents. The blacks in cattle find their best homologue in the gray mice blackened by the black and tan factor, or in the black rabbits due to the addition of Punnett's density factor to grays.

Whether the colors which appear similar in the different breeds of cattle are really so genetically could only be determined by careful experiments. Judging by appearances it is probable that the dun dilution factor of Highland cattle is found also in the Guernseys and Jerseys. The former appear to be eeDD and most of the latter EEDD. Kuhlman[13] reports on the cross of Jersey with black Angus. F_1 was black or very dark dun. In F_2 black, dark dun and orange fawn appeared. The general level of intensity appears to be higher here than in Highland cattle.

Probably there are variations in intensity which do not belong to the series discussed. Wentworth[14] has reported on a very interesting factor in the dark mahogany colored Ayrshires. He finds clear evidence of sex-limited inheritance. Heterozygous males are dark colored while heterozygous females are like ordinary reds.

War Causes Increase in Illegitimacy in Europe

Almost every country in Europe shows a slight increase in the relative number of illegitimate births since the outbreak of the war, according to Emma O. Lundberg of the Children's Bureau, in an address before the National Conference of Social Work. In England and Wales, for instance, between 1913 and 1916 the total number of births decreased 10.8% while the number of illegitimate births decreased only 0.2%. In Berlin, however, the number of illegitimate births in the first fourteen war months was 29% less than in a similar period before the war. France and Italy show some increase. At the same time, all the warring nations are making better provision for the protection and welfare of the illegitimate child, thus reducing the high death rate in this class of infants. As illegitimate children probably represent, on the average, an inferior sexual selection on the part of their parents, the effect of the war in increasing the gross and net illegitimate birth rate is distinctly dysgenic. Miss Lundberg believes that the war is not likely to produce an increase of illegitimacy in the United States.

[13] Kulhman, A. H. 1915. *Jour. Her.*, 6:68–72.
[14] Wentworth, E. N. 1916. *Jour. Ag. Res.*, 6:141–147.

Correction

In the October number of this journal, under the caption "The Too-perfect Milkweed," was published a photograph of the adaptation for cross-fertilization of the common milkweed. The story and legend under this photograph are entirely misleading. They were written by an amateur, and found their way into the journal owing to the fact that the editor has been drafted into military service. It is a familiar fact to students of botany that the flower base of the milkweed has no sticky substance on it but is furnished with remarkable perpendicular slits or openings larger below than they are above. As the insect alights on the flower, one or more of its feet slip into these slits and as it attempts to fly away, its claws slip upward in these slits and the hairs on its legs are caught and held tightly by a peculiar tough connecting contrivance like a clothes-pin, which holds the pollen masses or "pollinidia" together. These masses, produced in pockets one on either side of each slit, are normally pulled out by the insect as it flies away, and in drying they fold together like a book and are dragged by the insect into another flower, through one of the slits in its flower base. As directly underneath each slit the receptive stigmatic surface is located, the folded pollen masses are dragged over it and left sticking to it, where the pollen grains which compose the masses germinate and fertilize the flower. The trap occasionally fails to work and obliges the insect to depart without its legs, as is shown in the photograph. Weak insects are sometimes caught and die on the flowers.

Another error, on page 436, should be corrected. Captain Eben Putnam writes that his letter with regard to the draft of Old Americans in the New England states was written *before* the draft and merely declared that *if* certain conditions prevailed every citizen would be needed in some districts to fill quotas based upon enrollment.

DAVID FAIRCHILD.

Annual Meeting of the Eugenics Research Association

Dr. Henry E. Crampton, of Barnard College and the American Museum of Natural History, New York City, was elected president of the Eugenics Research Association at its annual meeting last month. H. H. Laughlin was elected secretary-treasurer, and Mrs. Winifred Hathaway and A. H. Estabrook were chosen as members of the council, the latter to succeed himself. Four scientific committees were provided for, as follows:

1. Committee on Personality Study: Dr. Adolf Meyer, Dr. August Hoch, Dr. G. S. Amsden, Dr. D. W. LaRue.
2. Committee on Inheritance of Mental Traits: Dr. Robert M. Yerkes, Dr. John B. Watson, Dr. C. B. Davenport.
3. Committee on Practical Application of Eugenics with Special Reference to the Mores: Dr. Irving Fisher, Dr. H. F. Osborn. Dr. Katherine B. Davis.
4. Committee on Eugenics and War: not yet appointed.

Mental Survey of a Workhouse Population

The entire population of a workhouse (132 men) in an Ohio city of 200,000 population was tested by Rudolf Pintner and Herbert A. Toops of Ohio State University. "For the purpose of a rough mental survey," they report, "this picture of the mentality of the group is no doubt characteristic. The population of this workhouse is made up of a few men of perfectly normal mentality, and of three other groups of about equal numbers, one of which may be characterized as slow, another as very retarded mentally but not sufficiently so as to be considered mentally incapable, and the third as definitely feebleminded or mentally incompetent. It is surely significant that no case tested above normal." The investigation is reported in the *Journal of Delinquency*, September, 1917.

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CONTENTS

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MONTH OLD BABE SUPPORTING ENTIRE WEIGHT BY GRIP ALONE

Although his muscles were so undeveloped that he was unable to hold his head up, this thirty-days-old babe was able to hang by his hands for more than one minute, and repeated the performance as often as the stick was put in his hands. This ability seems to be present at birth, but to decrease after the age of one month is reached. The thighs are bent at right angles to the body and the soles of the feet are approximated so that the entire attitude is more simian than human. This ability probably points to the old time arboreal life when the infant was forced to cling to its mother so that the latter might have her hands free. Photograph of a colored babe by John Howard Paine, through the courtesy of Dr. Price Hearst and Dr. Simeon Carson of Freedmans' Hospital. (Frontispiece.)

ARBOREAL MAN

Ancestors of the Human Stock Must Have Taken to the Trees at a Very Early Period—Tree-dwelling Habit Largely Responsible for the Success of the Stock in Evolution—Man in Many Respects Is Still Amazingly Primitive

IT IS sometimes supposed that man's ancestors acquired most of their "human" characters at the time they began to walk upright. But this supposition is not well founded. The traits of the human race seem largely to have arisen in the long period during which the ancestral stock lived in trees; and Dr. F. Wood Jones has written an extremely interesting book to point out some of the principal results of that arboreal existence.[1]

The evolution of the fore-limbs is one of the most striking features of man's progress. The legs of vertebrates are probably developed from the fins of fishes; and the earliest vertebrates, like the water newt and salamander today, doubtless had legs which served to balance the body but were hardly able to support it. A critical step was taken when, as in the Therapsids and Theromorphs, legs developed enough to walk on. To the primitive mobility was added an essential stability. But gradually the former had to be sacrificed to the latter, and in most quadrupeds the mobility of the fore-limbs long since disappeared. In man, however, it remains. The fore-limbs are not adapted to walking on, as anyone can testify who has tried to walk a hundred yards on all fours. The question is: Did man's ancestors ever walk on four legs, as most animals do? It is impossible, says Dr. Wood Jones, to believe that they did. The arboreal habit saved them from becoming quadrupeds, and thereby enabled them to acquire supremacy over all other forms of life.

"The arboreal habit alone is not the talisman; other mammalian stocks have taken to an arboreal habit; but they have taken to it after varying periods of quadrupedal life. They have taken to it too late to derive the full benefits from it, for they took to it with the fore-limbs already deprived of some of their inherited mobility. Such animals never become perfect tree-climbers. They may acquire an extraordinary skill in running about the branches of trees, as many rodents do, or they may even climb in the proper sense of the word, but in this climbing the grip is not obtained by the application of the palmar surface of the hand, but by the hook-like action of claws and nails; this method is practiced by many of the carnivora. The maximum of possibilities is not attainable in any of these cases." The power of *grasp* is all-important.

VALUE OF A HAND-GRASP

"The power to grasp with the hand and fingers seems such a very simple accomplishment that it is difficult to realize how such an apparently trivial beginning can have produced the tremendous changes that follow in its train. The power of the hand-grasp has made possible the forerunners of the Primates, has perfected the evolution of the Primates, and paved the way for the development of Man."

After an elaborate discussion of the anatomy of the forearm and hand in man and various other animals, Dr. Wood Jones says, "It would be a difficult matter to find the author who, writing of the human forearm and the human hand, has not seen in them the very highest and most perfect development of the animal kingdom. It has long been customary to lavish praise

[1] *Arboreal Man*, by F. Wood Jones, M.B., D.Sc., professor of anatomy in the University of London. Pp. 230, with many illustrations. London: Edward Arnold, 1916; New York: Longmans, Green & Co., Fourth Avenue and Thirtieth Street. Price $2.40 net.

upon this culmination of human perfections, or climax of evolutionary advances, as writers of different periods have judged it. Those modern authors who have seen so much in the so-called 'attainment of the erect position' (Munro) have been especially lavish in their praise of the human hand as a mere anatomical structure. Dr. Munro, in his presidential address at the British Association in 1893, permitted himself the expression that the human hand is 'the most complete and perfect mechanical organ Nature has yet produced.' Such a statement on the part of an anatomist can only be attributed to enthusiasm, and to a failure to differentiate between the very primitive anatomical condition of the hand and the perfection of this simple mechanism when linked to a human brain."

"After 1859 [publication of the *Origin of Species*] the forearm and hand, in common with every other feature of the human body, came to be regarded, not as a wonderful and specially designed structure, but as the perfected products of accumulated ages of evolution—the last thing in animal development and specialization. It is no overstatement of the case to say that Man was regarded by many as the last thing made, the culmination of evolution, and for some opponents of the new teaching and for some of its supporters he was the most modern animal. The orthodox chronology was accepted, the 'highest' form was the last form made, but instead of being the latest creation, he was the latest evolution. Huxley soon exposed the folly of this notion when it was definitely brought forward by an opponent. But though the statement of the idea as expressed by Mr. Gladstone may have been very crude, and its demolition easy by such powers of argument as were Huxley's, still, in more subtle guise the same idea becomes presented under many forms even today, and this not by any means necessarily from opponents of evolution, in such forms its refutation is not always easy. In even the most rigid and strictly scientific investigations in comparative anatomy this tendency is at times manifested. The human type of joint, or nerve, or muscle, or what not is so often assumed to be the last perfected—the culminating type. There is a vague idea, which insinuates itself in many ways, that the human type of structure must be derived from, and have passed through, stages seen in a series of 'lower' animals. A foolish argument may be permitted in dealing with a folly. Were a horse capable of writing works on comparative anatomy, he would probably, and with far more justice, regard his race as being the last effort in evolutionary chronology, and he would, and again with far more justice, derive his highly specialized limbs from those of some such primitive form as Man."

FOREARM IS PRIMITIVE

In these hypothetical horse compositions "there is no doubt that the human forelimb would suffer badly. Far from being regarded as the acme of evolutionary processes, it would be judged as an extraordinary survival of a very primitive feature far into the mammalian series, and more would be written upon its striking similarity to the corresponding member in the salamander and the tortoise than of its adaptation to the multitude of human functions."

"We have hurriedly reviewed the process by which a mammal with four undifferentiated and mobile limbs achieved the emancipation of its forelimb by its climbing activities. It is now necessary to make an attempt to follow the changes which take place in the hindlimb under the same circumstances." The most primitive hindlimb that can be imagined is in every way the counterpart of the forelimb; it changes because of the fact that most of the weight of the body is thrown upon it in climbing.

"The arboreal habit conferred its benefits by emancipating the forelimb from the duties of support and progression, and, by differentiating its functions from that of the hindlimb, it saved the animal from becoming quadrupedal. In differentiating the functions of the two sets of limbs, the animal gains a great deal. Some ani-

A VERY PRIMITIVE TYPE OF LEG

The salamander, shown above, has an exceedingly primitive leg, which is of value to him in paddling but hardly adequate to support the weight of the body. It is supposed that the mammals descended from a form something like this, with legs that were of very little value. Some of the mammals, such as the horse, developed highly specialized legs; but the human stock retained its members in a relatively primitive condition, a fact which has been of tremendous value in the evolution of man. Photograph from above natural size by John Howard Paine. (Fig. 1.)

mals, one might almost say, have gone too far in adapting themselves to the arboreal habit. An animal, saved by the arboreal habit from becoming quadrupedal, does not gain the maximum of the benefits derivable from its new mode of life, if it is saved from this fate only to become quadrumanous. Four feet do not lead far in the struggle for mammalian supremacy, four hands do not lead a great deal farther. It was the differentiation into two hands and two feet that provided the great strength of the stock from which man arose."

"The human hand, a strangely, almost shockingly, primitive survival, has received enormous praise mistakenly lavished by the philosopher and the anatomist; but the human foot, a wonderfully modified and distinctly human member, has had but scant appreciation. . . . The foot is apt to be regarded as a poor relation of the hand, as a thing which, once being far more useful, has degenerated, within the narrow confines of a boot, into a rather distorted and somewhat useless member. Although in modern Man the

boot has had its definite influence (as in limiting the possibilities of the power of grasp), such generalizations concerning the human foot are very far from true. If Man should wish to point with pride to any organ, the structure of which definitely severs him from all other existing Primates, it is to the foot he should point. If 'missing links' are to be tracked with complete success, the foot, far more than the skull, or the teeth, or the shins, will mark them as Monkey or Man. The weakness of Achilles lay in his heel; the weakness of the arboreal Primate masquerading as man lies in the structure of its foot."

To one who is not an anatomist, the most striking difference is in the relative lengths of the toes. In the Gorilla the middle digit on both hand and foot is the longest. The "digital formula" for the foot is exactly the same as for the hand; both may be expressed as: $3>4>2>5>1$. Such a formula is an exceedingly primitive one, and is found as low in the scale as in water tortoises, at the present day. "The strangely primitive human hand has an identical digital formula, the third being the finger that reaches farthest forwards, the fourth the next, the second the next, followed by the fifth, and the thumb is farthest back of all. There is an almost equally common variation in the human hand in which the second digit may be as long as, or longer than, the fourth, and this is doubtless due to the functional importance of the index finger. I am not sure that it should not be considered as the typical human condition. In such cases the formula stands thus: $3>2>4>5>1$, or $3>2=4>5>1$.

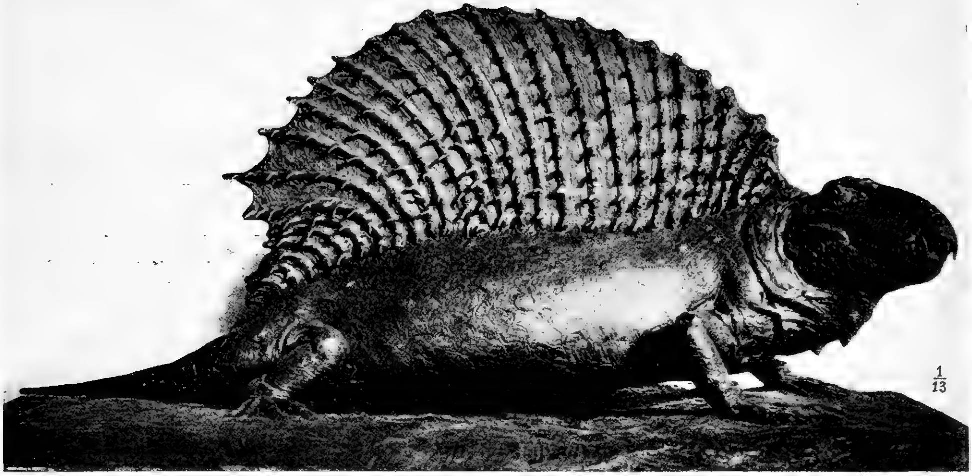
"Man retains a very primitive digital formula for his hand. His nearest Primate kinsfolk retain it for both hands and feet.

ALTERATIONS IN THE FOOT

"It is when we attempt to apply this formula to the human foot that we see how great is the alteration that has taken place between the existing anthropoid with the best primate foot and Man himself. The digital formula for the human foot is as a rule: $1>2>3>4>5$. Such a statement holds good for a majority of the present-day British people. It is commonly assumed by artists, and even by surgeons, that the elongated big toe which projects in advance of the other four toes is not a natural human characteristic, but is a result of boot pressure. A long big toe is regarded rather as a deformity than as a natural human possession in which to take justifiable pride.

"Professor Flower long ago turned his attention to this point, and he examined the feet of hundreds of the barefooted children of Perthshire, and among them all he found no case in which the big toe did not project beyond the second toe. We must look upon a big toe which dominates the whole series as a typically human and a perfectly natural feature. Nevertheless, it is common enough to see feet in which the second toe is longer than the big toe. People who have feet with such a digital formula are apt to be somewhat proud of the fact, for such a foot is supposed to conform to the 'Greek ideal,' but that this type of foot was ever the ideal of the Greek artists is disputed by some authorities on the subject, and certainly we may assume that it is less typically human, and more ape-like, than the type of foot of the average hospital patient who possesses a long big toe."

"Zoologically speaking, we may say that the very useful and specialized foot adapted for terrestrial progression is a foot of few digits. It may, in fact, be a foot composed of a solitary digit. The evolutionary stages by which the horse has come to stand solely upon its third digit are well known. Similar processes produced the two digited foot of the deer and of the ostrich. There can be no doubt that Man is trusting, not to his third digit, but to his first, and that all the others are undergoing a process of comparative atrophy. This is in reality a most interesting problem. There is an admitted tendency to specialize one digit in a thoroughly adapted terrestrial foot. Man applied an arboreal foot to terrestrial progression, and in this arboreal foot the



THE THEROMORPH HAS A LITTLE SPECIALIZED LEG

This animal, one of the extinct reptiles, represents a stage slightly above that of the newt-type, the legs now being strong enough to support the body on land, but still not specialized for rapid movement. The Theromorphs, of which the above is a model of a Naosaurus from the Permian strata in Texas, by Charles R. Knight, are supposed by many to represent the type of reptile from which the mammals (man among them) took their rise. The human stock took to the trees at an early date and thereby avoided having to develop legs for running on the ground. Other animals which developed such legs did not succeed in developing their brains to the extent that the tree-dwellers did. After Henry Fairfield Osborn, in *Fossil Vertebrates in the American Museum of Natural History*, Volume iii, Plate IX, 1904-1908, page 265. Restoration by Charles R. Knight. (Fig. 2.)

best developed member was the old grasping digit—the first or big toe. It seems that upon taking to a terrestrial life he has started the elaboration of this already specialized toe, and is tending toward the development of a foot which is quite unique—a foot in which the first digit is the dominant, and in the end, perhaps, the sole surviving, member.

DEGENERATION OF THE LITTLE TOE

"It needs no special demonstration to make plain the fact that the little toe is somewhat of a rudiment in most Europeans. Usually it is but a poor thing; its nail is ill developed, and at times no nail is present. It is particularly liable to that circulatory disturbance which manifests itself in chilblains, and not uncommonly it seems in a poor state of nutrition. Most people possess but little power of movement in it, and its skeleton shows that its atrophic condition has affected the bones and the joints, for the last two phalanges are very commonly fused together, making it short of a joint as compared with the other toes. Very commonly its axis is not straight, and the toe is humped up and also somewhat bent laterally.

"It is easy to assume that all this is merely the result of wearing boots, but it is perfectly certain that this common explanation is not the correct one.

"In many races, the members of which are quite innocent of wearing boots at any time of their lives, the little toe is just as atrophied as it is in the average London hospital patient, and in some unbooted native races it is even more degenerated that is common in the booted Londoner. Among the Malays, the absence of a nail upon the remarkably stumped fifth toe is not at all uncommon. The barefooted races in Nubia are no better off in this matter, and even in the very primitive Sakai the

little toe has suffered." Similar conditions are noted in various other savage races, and are found in Egyptian mummies (see Fig. 5).

As a rule, the terminal joints of the toes are the first to degenerate. "One very curious evidence of this skeletal condition is seen in very many feet, even when the big toe is far in advance of all the rest. Although a line joining the tops of the toes slopes without interruption from the first to the fifth, a line joining the bases of these toes does not follow the same course. From the first cleft it rises to the second, and from the fourth cleft it rises to the third, and there is thus produced a sharp angle in the line which usually falls opposite the middle of the base of the third digit. This line has exactly the same contour as in the hand, and is the typical one seen in the monkey's foot." It is the outer toes which are undergoing atrophy, and the atrophy begins at their outer ends, hence it has not yet affected the primitive outline of the foot.

CHANGES IN THE FACE

Accompanying the liberation of the forelimb and the use of the hand for feeding, there went a recession of the snout which has produced some well known changes, particularly in the teeth. The preparation of food by the hand is carried farther and farther; the teeth no longer have bones to gnaw or nuts to crack "and it is not to be denied that, slowly, of course, but still surely, they are undergoing atrophy. Among existing races of mankind the fact is patent, the observation is a commonplace of anthropology. The possession of an ample palate and large, well-formed teeth by the black races is a matter of common knowledge (as is the fact that in the crania of the prehistoric inhabitants of Europe the size and quality of the teeth were superior to those at present obtaining in the same geographical area). It is therefore impossible to overlook the inference that reduction in the size of the teeth is at least attendant (if not dependent) upon the acquisition of higher grades of civilization and directly upon diet and the preparation of food.

"This, from the writings of Dr. Duckworth, may be taken as an orthodox statement of the general position as summed up in modern anthropology. The more primitive races have larger and better formed teeth, rooted in more roomy palates, than members of more civilized races can boast of."

The third molars, wisdom teeth, being the last to be erupted in the already diminished jaws, show the maximum effect. In modern civilized Man these teeth are erupted late, sometimes not at all, or in only one jaw. They are always small, and frequently do not meet and bite together. They are liable to early decay. "In primitive races they are rarely absent, they are cut earlier, and are but little if any smaller than the other molars, and they bite and grind together in a perfectly even manner."

The recession of the snout has already been mentioned; the recession of the chin is equally to be observed. "The dawn of a chinless aristocracy is no pleasing picture in the later stages of human evolution; and yet the recession of the modern jaw is not to be denied." One of the effects is to overcrowd the teeth, so that while man has fewer teeth than his relatives, they are closer together. "Man is the only living primate that has its teeth arranged in a continuous series, and it is one of his distinctions that there are no gaps between them. The process of the shortening of the snout, outstripping the process of reduction of the dental series, gives rise to one of the great problems of modern dentistry—the proper treatment of the many evils arising from overcrowded jaws."

ABDOMINAL EFFECTS

In the vague general idea that man, from walking on all fours, suddenly began to walk upright, this supposed change is thought to have had many evil consequences by forcing a readjustment of all man's viscera. The tendency to rupture is one of numerous such supposed consequences. But Professor Wood Jones points out that this

THE FOUR HANDS OF AN ANTHROPOID

The hands of the great apes are not much inferior to those of man, and their feet are almost as good as their hands for grasping. Now it is supposed that the development of the power of grasp is one of the things that gave the human stock its supremacy in the evolutionary competition. Since the anthropoids are better endowed for grasping the limbs of trees than is man, why should they not have gone ahead? Photograph by E. R. Sanborn, New York Zoological Society. (Fig. 3.)

picture has been greatly overdrawn; for if man's ancestors were arboreal, and perhaps never ran about on four legs on the ground, it must be noted that an animal sitting in a tree is almost as upright as is one standing on two legs on the ground.

"The upright poise of Man has been lauded as one of his greatest distinctions. This praise of human uprightness has, without doubt, been carried to absurd extremes, so also has the tendency to ascribe to this same uprightness a multitude of human weaknesses and disabilities. This visceral uprightness is no new thing; the readjustment has been gradual, and some measure of it has been very long established. It is easy to overdo the praise of the poise. It is equally easy to overdo the condemnation of it as a cause of many human ills."

One of the consequences of arboreal life which has not often been emphasized is the reduction in number of offspring. Large litters can only be produced where the female is living in a sheltered situation during pregnancy; they can only be cared for in a position that is much safer than a tree-top. But Professor Wood Jones ascribes to the arboreal habit a change of still greater importance—that which has produced the human brain.

In the forerunners of the mammals the sense of smell was the principal "mental" possession, and this continues to be true even in many low

mammals, among whom "friends, and food, are found by their scent; foe are avoided by the same sense, and the whole sexual life of the animal is lived in a like atmoshpere." But when Man's ancestor's took to the trees, the sense of smell became of less importance, for no trail of scent is left among the trees as it is on the ground. The uselessness of the sense of smell opened the way for the development of the other senses, and of other parts of the brain, to the great degree in which Man now shows them. Nevertheless, this primeval sense which in modern man is none too well developed and is a very minor factor in his life, "still shows a subtle power as a memory sense. Dudley Kidd has noted this feature in investigating the psychology of Kafir children. 'When Kafirs are questioned as to their earliest remembered impressions they usually state that these were connected with the senses of taste and smell. The next things they remember are connected with the sense of color; then impressions of sound and of form seem to follow last of all.' In still more primitive races the importance of smell impressions is probably greater; and there are few of us who have not some complex memory picture associated with an early impression of smell."

THE SENSE OF TOUCH

The sense of touch was likewise modified by arboreal life, coming to be centered largely in the hand. This helped emancipate the animal from its domination by the sense of smell, and it contributed to the development of new areas in the brain.

The evolution is evidently harmonious in its details. The more the fore-limb becomes emancipated, the less is the hand called upon for menial duties which in other stocks necessitate the development of skin-thickenings, pads, callosities, or hoofs. It is the freed hand which is permitted to become the sensitive hand, and it is the freed and sensitive hand which now, so to speak, goes in advance of the animal and feels its way as it climbs through life. The animal no longer smells out an object subsequently to feel it with its nose: but it feels with its hand some object that comes within its reach in the customary round of arboreal activities, and it may or may not subsequently add to its knowledge of the object by smelling of it. Tactile impressions gained through the hand are, therefore, constantly streaming into the brain of an arboreal animal, and new avenues of learning about its surroundings are being opened up as additions to the old olfactory and snout-tactile routes. With the development of the power of grasp, new and great possibilities come in. Much may be learned of an object that can be felt by the hand; much more of an object that can be grasped, lifted and examined in the hands. When an object can be grasped and lifted it can be examined from every point of view, and the eyes must play a large part in this examination. Its whole outline, the texture of its surface, its hardness or softness, its size, temperature, and weight, can all be ascertained. It is difficult for us, with our perfected cerebration, to appreciate the difference which the power to grasp an object makes to an animal attempting to learn the nature of objects with which it comes in contact, but we may be sure that the difference was very great, and was made greater when the power to pick up the object and to examine it from all points of view was added.

HIGHER MENTAL FUNCTIONS

It is even possible, Professor Wood Jones thinks, to connect the evolution of higher mental functions with the arboreal life of man's ancestors; to find a partial clue to the origin of those "higher ideals of conduct" which some critics have alleged could not possibly be explained on an evolutionary basis.

It has already been pointed out that arboreal life leads to a reduction of the number of young produced at a birth. This is, of course, a mere adaptation to life circumstances, and is not confined to the Primates but will occur wherever there is no natural nursery for the young. If the tree-dwelling ape has but a single young at a birth (as a rule), so do the horse and the whale.

DID THE ANTHROPOIDS FOUND THE PERMANENT FAMILY?

Lower mammals whose progeny are able to fend for themselves within a comparatively short time after birth are rarely paired for long. The offspring, being able to take care of themselves, break away from their parents, and as there is no further dependence on the male for defending the offspring and mother, the parents soon separate, and form other combinations the next year. But in the Primates, as the period of dependence of the young becomes lengthened, the dissolution of the family ties is delayed more and more until it eventually is delayed until the recurrence of the next mating season. Thus the union tends to become permanent. Photograph by E. R. Sanborn, New York Zoological Society. (Fig. 4.)

Large families can only be indulged in by animals that can have a safe retreat in which to rear their numerous young, or by animals sufficiently equipped with weapons to guard them.

"Of those animals which, having no nursery to hand, have a reduced litter, there are two distinct classes. The first class, for which we may turn to the horse (as a representative of the Ungulates) for an example, is made up of animals whose roaming life is composed of a series of escapes from danger: animals that depend for their safety not upon their retreat into burrows, holes, or any other fastness open to some smaller beasts, but upon the swiftness of their open escape. These cannot be successful if the females are handicapped by the disabilities of pregnancy with large litters, or by the nursing of helpless offspring. In them the number of offspring is reduced, and the usually solitary infant is born singularly mature, so that it may share as soon as possible in the life-saving activities of its species.

"The solitary young of such animals is born grown up, it can flee at its mother's side within a few hours of its birth. Its period of dependence upon its mother is relatively short, and there is but little infancy, or childhood for such a baby. In the second class come the arboreal animals. There is no natural nursery among the tree-tops, and the disabilities of pregnancy with a large litter are felt as keenly in active tree-climbers as in any class of animals. No doubt nest-building was resorted to as a temporary expedient in the arboreal stock; and among all the arboreal and semi-arboreal animals, derived from many orders, nest-build-

ing, in some members, is still the rule. But nest-building only overcame a temporary disability, and in the end, reduction of the family solved the problem.

THE PRIMATE BABY

"The baby of the perfectly adapted arboreal animals of the primate stock is solitary; but it is a baby very different from that we have pictured in the previous group. The arboreal baby is born immature, and it is singularly dependent upon its mother in the precarious circumstances of life among the branches. There would seem to be no alternative in such a life; the baby must either be born a perfected tree-climber, or it must be a more or less immature creature dependent upon others for its safe conduct among the branches. As a matter of fact, the offspring of the Lemurs and Monkeys are born immature and comparatively helpless, save for the power of grasp which is well developed in their hands. Naturally they cannot immediately follow their mother upon her arboreal excursions; and among the Lemurs it is the rule for the young to grasp the mother, and among the Monkeys for the mother to assist by grasping the baby with her wherever she goes; this, at the outset, is a new factor in the relation of mother and offspring. We may surmise that in this new relation there is given a wider scope for the working of that very primitive display of instinct summed up in the commonly used phrase 'maternal care.' Maternal care is, of course, perfectly well manifested in animals situated very differently from those we are studying; it is, in some of its manifestations, a widespread and primitive animal instinct. But the phrase 'maternal care' when applied to a mother that, in time of danger, defends a dozen helpless offspring connotes something rather different from its extension to a mother that carries a solitary offspring which clings to her throughout a somewhat prolonged infancy.

"It is to be regretted that observations upon the intimate details of the lives of the Primates in their natural state are not made more frequently by those having the opportunity to do so. Among the Lemurs, Charles Hose has noted how *Tarsius* carries its baby in the way common among cats, by picking it up with the teeth. It evidently does not nurse its offspring. The young *Nycticebus tardigradus* clings tight to the mother, and the mother makes but little effort to handle the young. It will bite savagely if an attempt is made to remove the baby from its fur, but, as a rule, it resents any other interference in exactly the same manner. On one occasion a female *Nycticebus* escaped from its cage at night, and left its baby, which was still suckling, to its fate. The baby, which was reared on the bottle, used its voice freely each evening, but the mother, though living in some trees quite close to its cage, never returned to it. The voice of the mother was heard on rare occasions, but five years passed before her actual home was discovered; even then she was still within a few paces of the spot in which she started her freedom, and in the meanwhile the young one had died.

MONKEY MOTHERS

"I do not know of any recorded observations which show that in the Lemurs the maternal instinct is very much developed beyond its display in carrying the helpless baby clinging to the mother's fur. With Monkeys, however, the care for the young is very real, and several observations have been recorded upon this point. Both in their natural state and in captivity, Monkeys show the greatest concern in the well-being of their offspring. That they will defend them from attack is nothing, for such a display of maternal instinct is the common property of most living creatures, but the Monkeys go further than this in the development of those numerous tendernesses for their young which in all accounts are, and can only be, likened to human parallels.

"With the Anthropoids, so far as opportunities for study in their natural state have been permitted, there is every evidence that maternal and pa-

ternal care is carried still further. Many observers have noted the human manner in which the Gibbons attend to their young, and the mothers have been seen to take their babies to the water and carefully wash and dry them (Bock); even the Gorilla has been seen to correct its offspring by boxing its ears when it misbehaved (Koppenfels). Not only is the display of maternal care much more marked in all these higher arboreal Primates, but it is exercised for a much longer period than in any other animals. Arboreal Primate babies have a very long babyhood and a long infancy. The baby Gibbon (*Hylobates lar*) clings to its mother for about seven months (Blanford), and it is not fully mature until it is fourteen or fifteen years old (Hartman). The young Orang-utan is dependent upon its mother for about two years, and is not fully adult until it is fifteen (Forbes).

"This prolongation of infancy, and the period of youthful dependence, has probably a rather widely reaching influence. It calls for a much more prolonged exercise of parental care and control, and causes these attributes to be more or less permanent characteristics, rather than periodically recurring manifestations of an instinct. Again, the prolongation of infancy may be said to be the especial factor which created the family as a social unit. In almost all the higher vertebrates it is the habit of the male parent to remain with the mother during the helpless early stages of the offspring, and in many instances (in several orders) he even plays his part in caring for the young during their most dependent period. In the Primates, the share that the male takes in the duties of parenthood has often been noted. The males have repeatedly been seen to carry the young on their arboreal journeys, and it has even been asserted that the male of the Siamang Gibbon (*Hylobates syndactylus*) always carries the baby if it be a male, the female parent carrying only the female offspring (Diard).

AN EGYPTIAN TOE

The atrophy of the little toe in many modern feet is sometimes supposed to be due to wearing boots. But it seems to be a general evolutionary trend, which is tending to reduce the human foot to a single toe (the first or big toe). This foot of an Egyptian mummy of the XX dynasty, about 1300 B. C., shows that the little toe was in a deplorable state even then, centuries before boots appeared in Egypt. The last phalanx is diminutive and its joint is ankylosed. Photograph from Dr. Gorgy Sobhy, School of Anatomy, Cairo. (Fig. 5.)

FOUNDATION OF THE FAMILY

"In whatever degree parental duties to the helpless offspring are discharged by the male arboreal Primate, it is evident he is only fulfilling a general biological law; but it also follows that if infantile helplessness is prolonged, his parental duties are liable to a similar extension. Here is evidently the beginning of that association of mother, father and child which, lasting beyond a brief period comprised in courtship, the suckling of helpless young, and the guarding of mother and off-

spring, lays the foundation of the family.

"When infancy is brief, the family bond is similarly of short duration; and, the period of suckling being ended, there comes a time of expansion of infantile enterprises, a time marked by some internecine strife and much parental intolerance. It becomes a necessity for the mother to repel the young when mammary activity is ended; it devolves upon the father to chastise any possible rivals: and in most large littered animals the family tie loosens and dissolves as soon as the young are fully capable of fending for themselves. As the period of dependence of the solitary offspring becomes more protracted, the advent of the dissolution of the family is naturally delayed—it may be delayed until the recurrence of the next natural parental sexual season. This I imagine to be a very important factor. If the bond of the helpless offspring keeps the male in attendance until the next sexual period of the female, there is likely to be a recurrence of the whole process, and a step towards the permanence of their union."

THE HUMAN BABY

It is well known that details of the ancestral life of an animal can often be inferred from a study of it during infancy, and Dr. Wood Jones' chapter on "The Human Baby" is not the least interesting part of his book. Recalling that the arms of other Primates are longer than their legs, while the reverse is true in man, he points out that at one stage in the development of the human embryo the arms actually exceed the legs in length. Later the proportions are reversed. Even at birth, however, the baby's legs are relatively short compared to its trunk. The baby's feet resemble those of the anthropoids in being turned inwards, so that the soles can be pressed against each other—this indeed being a common position of rest in an infant as well as in an arboreal anthropoid. When children learn to walk, it is upon the outer sides of their feet that they trust their weight, exactly as the anthropoids are wont to do. It is this inherited arboreal foot-poise which leads children to wear out the outer edges of their shoes first. The remarkable grasping power of a new-born infant is likewise cited as the survival of a trait that possessed life and death importance in the tree-tops. Finally, with reference to the much-talked-about upright posture, the author remarks succinctly that "the human child sits up before it stands; the human stock sat up before it stood."

But, it may be objected, many other mammals have lived in the trees; why did they not progress as far as the human stock? From what has preceded, the answer is perhaps obvious. Either they took to the trees too late, after they were already specialized (as the squirrels, for instance), or once there they became specialized too far (as the bats, or the apes and monkeys which have four hands instead of two hands and two feet). It need not be pretended that this answer is all-sufficient, yet it undoubtedly contains a large part of the truth. Man's success in evolution must largely be ascribed to the fact that he has (except in brain) not evolved very far; he is in many respects still amazingly primitive.

Maine Station Collects Breeding Records

The Maine state experiment station has been for some time collecting information from cattle breeders of the state about their breeding operations. So far this cooperative project has made available data on cattle breeding from 192 different herds, including 3,085 cows and 217 bulls. Analysis of this material should produce some valuable results.

EUGENICS IN JEWISH LIFE[1]

Until Recently, Religious Customs Have Tended to Produce a Large Amount of Intellectual Ability, but Also a Large Amount of Defect—Changed Manner of Life Brings New Eugenic and Dysgenic Changes

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AMONG the many paradoxical peculiarities of the contemporary Jews there are some which are of immense interest to those engaged in the study of eugenics. The striking phenomenon of their survival as a religious and social group, despite their dispersal in all parts of the habitable globe, under all varieties of climatic conditions, is the more remarkable when it is borne in mind that after 1,800 years of severe and cruel persecution there are at present more Jews than there have ever been at one time. C. W. Saleeby, one of the best-known apostles of eugenics in England, is inclined to the opinion that it was the intense struggle for existence that made up their greatest source of unexampled strength; that the Jew who was a weakling or a fool had no chance at all. "The weaklings and the fools being weeded out, intensity and strength of mind became a common heritage of this amazing people," says Saleeby. To him the Jews, constituting "the one human race of which we know assuredly that it has persisted unimpaired, have been the most continuously and stringently selected of any race that can be named."

This theory of survival of the Jews, not in spite of persecution, but because of it, is not original with Saleeby. Many others have propounded it before, and some have even urged ruthless persecution of the unfit as the best means of improving certain elements of humanity, thus assisting "selection" through the survival of the fittest.

What are the facts about the number of able and talented Jews? It is well known that the proportion of persons of marked ability, of individuals who have gained distinction in any line of human endeavor, is much greater among the Jews than among the peoples of other faiths in whose midst they live. There is no need of burdening the reader with statistical figures substantiating this fact, which is well known to everyone who has given some thought to the subject. One has only to consider the enormous number of financiers, merchants, manufacturers, physicians, lawyers, musicians, artists, journalists, scientists, etc., of Jewish origin in Europe and America, and bear in mind that the children of Israel constitute but a small fraction of 1% of the white population of the world, to be convinced that the number of talented, able and successful persons among them is in excess of what would be expected if they did not excel in this direction.

But there are facts, indeed, uncontrovertible facts, showing quite the contrary.

It is a matter of common observation that the Jews are physically puny —a large proportion are feeble, undersized; their muscular system is of deficient development with narrow, flat chests, and of inferior capacity. They make the appearance of a weakly people, often actually decrepit, if only because of the proverbial bent spine, the "Ghetto bent." Moreover, physical defects, congenital and acquired, are notoriously common among them.

MANY DEFECTIVES

It is noteworthy in connection with the statement of Saleeby quoted above

[1] Extracts from an article published serially in five numbers (Jan. 26, Feb. 2, Feb. 9, Feb. 16 Feb. 23, 1917) of *The American Hebrew*, 44 East 23d Street, New York.

to the effect that fools have been weeded out from among the Jews, that the proportion of mental defectives, idiots, imbeciles, etc., is much higher among them than among others. It is of immense interest from the standpoint of eugenics that hereditary and degenerative defects are more frequent among them than among people of other faiths who live under a similar social and economic environment. Thus, blindness, color blindness, deaf-mutism, idiocy, imbecility, insanity, etc., have been found from two to five times more often among them than among the Christians in Europe. Eliminating most of the possible sources of error, as I have done in my book, *The Jews*, it must be acknowledged that the modern children of Israel, in spite of their phenomenal vigor in other respects, show a larger proportion of physical and mental defectives than any other civilized religious, social, or ethnic group of people.

We thus have, to a noteworthy degree, two diametrically opposed extremes among the modern Jews. On the one hand we have a very high proportion of feeble-minded, idiots, imbeciles and insane and also physical defectives, weakly and decrepit people; and on the other hand we saw that we have also an amazingly high proportion of persons of marked ability in nearly all walks of life, especially such as have attained eminence in the intellectual, commercial and industrial fields of human endeavor. These are facts which have great bearings on the subject we are about to discuss.

Sociologically, this contrast is even more strikingly evident among the modern sons of Jacob. There are found among them an excessive proportion of poor and destitute dependents, as well as a larger ratio of economically prosperous, and even millionaires, than their total number would lead us to expect. The popular envy of the "rich Jew" is based on the excessive proportion of successful Jewish bankers, merchants and tradesmen; while the frequently repeated pity expressed for the hordes of poverty-stricken and famishing Israelites in eastern Europe and the Orient, as well as the destitute aliens in London, Paris, Berlin and New York, finds its justification in the large number of Jews who are physically and mentally unfit for the intense struggle for existence demanded by modern life.

What are the causes of these peculiarities among the modern Jew? The sterotyped answer given by many writers that these, as well as most other characteristics of the Israelites, are the expression of the "racial peculiarities" does not hold in the light of recent research. Elsewhere I have shown that there is no such thing as a homogeneous and pure race, and that we can no more speak of racial unity among the Jews than we can speak of racial purity among those professing Christianity, Mohammedanism, or any other religion. Indeed, we find ethnically all kinds of racial elements among the contemporary followers of Judaism. Granting this, we must conclude that "race" cannot be considered the cause for these social, economic, and pathological differences between the Jews and the peoples among whom they live.

INFLUENCE OF RELIGION

We must bear in mind that up to about seventy-five years ago practically all the Jews in Europe and elsewhere were orthodox, and intensely religious. To the orthodox Jew the biblical ordinances, as well as the opinions of the rabbis, are binding in matters of matrimony just as in everything else. Jewish life in the medieval Ghetto was permeated by the spirit of the rabbis and shaped in accordance with their notions. Their marriage and divorce laws are remarkable and, on the whole, more in accordance with the principles of eugenics than the Christian and Mohammedan marriage laws. There are, however, some important exceptions which will receive attention later on.

Every Jew is in duty bound to marry and procreate as early in life as possible. According to the *Schulchan Aruch*, the recognized Jewish code, "it is the duty of every Jewish man to marry a wife in his eighteenth year, but he who anticipates and marries earlier is follow-

ing the more laudable course, but no one should marry before he is thirteen." According to the Talmud, a Jew who has not entered matrimony at twenty is damned, and the rabbis frequently compelled delinquents to marry.

The medieval Jews, and those in Poland as late as the middle of the nineteenth century, followed the Rabbinical ordinances implicitly. Most of the Jewesses were married before they reached the age of sixteen, and the husbands were not much older on the average. The oriental Jews are even at present apt to marry as early, and I saw in Algeria and Tunisia Jewish couples the combined age of whom was hardly over thirty. At present in Europe and in America such early marriages are exceedingly rare; indeed, it appears from statistical evidence gathered in various countries that the average age of Jews at marriage is even higher than that of the Christians among whom they live.

I do not know of any other social or religious aggregate that encouraged and practiced positive eugenic life to such an extent as the Jews did in the Ghetto. Most of the Rabbinical teachings are teeming with positive eugenic suggestions[2] and one is inclined to say that the rabbis anticipated Galton by about sixteen hundred years. They deprecated the marriage of a woman for her wealth, and urged that the daughter of the respectable family is most desirable for a good Jew; especially should the brothers of the bride be good and respectable men, for the character of the children is greatly dependent on the qualities of the mother, according to the rabbis.

The Talmud advises a good Jew to sell all he has in order to marry the daughter of a learned man. A marriage between the daughter of a priest, or of a learned man, and an ignoramus will not be successful, and all the promises of the prophets will be fulfilled upon him who gives his daughter in marriage to a learned man. The families most desirable for matrimonial alliances are classified by the rabbis in the following order: Those of the scholar; the most prominent man in the community (what Galton calls "civic worth"); the head of the community; the head of the congregation; the collector of charity; the teacher of children; while the children of an ignoramus are to be avoided, and one should not give his daughters to such persons.

PREMIUM ON INTELLECT

It is thus evident that the Rabbinical laws, which guided the orthodox Jew in his matrimonial affairs, place most reliance on the intellectual attainments of the contracting parties and their parents, thus increasing the chances of productivity of the best stock. In other words, *guided by these Rabbinical teachings, the medieval Jews' ideals of marriage centered themselves in the intellect of the prospective sons and daughters-in-law, and also that of their parents. They apparently were great believers in the potency of heredity and acted accordingly.* The rich sought young men with attainments in learning, and when they could not find suitable young scholars among those in their own social and economic status, they did not hesitate to take poor but learned young men for their daughters.

The rich and the learned thus formed castes among the Jews almost as stringent as those of India, abstaining from intermarriage with the poor to a certain extent, and especially and emphatically with the ignorant and lowly. The ideal of the rich Jew in the Ghetto has always been to give his daughter in marriage to a rabbi, and there were very few rich families which have not attained this ideal with at least one daughter. Even if the son-in-law was not expected to practice his profession and went into business after marriage, his diploma to the effect that he was sufficiently learned in the law to be qualified as a rabbi was sufficient to place him in the category of aristocrats.

Riches alone was not *Yichus*, or

[2] An outline of the eugenic aspects of Jewish life prior to the dispersion was given in "Jewish Eugenics," JOURNAL OF HEREDITY, VIII, pp. 72–74, February, 1917.

aristocratic stock, in the Ghetto; the *lamdon*, the scholar, was the real aristocrat no matter what his parentage was. When a poor but capable and promising boy was discovered in the community there was sure to be found a rich man who would undertake his support till he reached maturity and married his benefactor's daughter. The scholar was even supported by his father-in-law for many years after marriage, often for life. In this manner the marriage and parenthood of the favored and best stock, *i. e.*, of persons of marked ability and civic worth, was greatly enhanced almost to a degree satisfactory to those who, with Galton, advocate radical methods of positive eugenics.

Jewish marriage laws, customs and habits have, however, not only been effective in encouraging the augmentation of the favored stock. We also find strong and active dysgenic tendencies which have been instrumental in encouraging the proliferation of an enormous number of physical and mental defectives among the children of the Ghetto. To begin with, even the rich usually cared but little for the physical appearance of the men they chose for their sons-in-law. All they cared for was the intellectual attainments of the young men; even deformities may not have militated against prospective bridegrooms, provided they were scholars of eminence or promise. They were, however, careful about the appearance of their prospective daughters-in-law, because the Talmud appreciated beauty in a woman, and every Jew was urged to marry a handsome wife; a dark-complexioned man should better marry a fair-complexioned woman, etc. This may, to some extent, explain why there are at present so many beautiful Jewesses among the inhabitants of the Ghetto, while beautiful men are rather scarce. Social selections may have had its effects.

DYSGENIC INFLUENCES

The most remarkable and far-reaching dysgenic factor operative among the Jews for centuries has been the institution known as *Achnoses Jaleh*—societies having the object to provide trousseaus and dowries for poor maidens in Israel. Unmarried persons of either sex were practically unknown in the Ghetto; every Jew had to marry and to procreate. In case of young men or women who were either too poor to venture into matrimony, or because of some infirmity, physical or mental, could not find consorts willing to cast their lots with them, these societies provided opportunities, and funds, to unite these defectives with life partners. Every physical and mental cripple was thus encouraged to marry and to bring legitimate offspring into the world. Occasionally it was necessary actually to force this sort of individual into matrimony and parenthood. A blind boy was united with a lame girl; deaf and dumb were coupled; the town fool was given a paralyzed wife; the insane was encouraged to marry an imbecile girl, etc. Public-spirited Jews, especially Jewesses, collected money to provide these unfortunates with trousseaus, cash dowries, furniture, etc. These defectives proliferated, no doubt, at a higher rate than healthy individuals, leaving a stock of degenerate offspring which were a burden on the Jewish community till they reached maturity, when they, in turn, offered opportunities to pious Jews and Jewesses to raise funds with which to marry them off.

I have already spoken of the professional marriage broker, the *Schadchen*, and his rôle in Jewish Ghetto life. Indeed, among the Jews, he was an institution; while peoples of other faiths have made use of marriage brokers, among the Jews he was more often called into service. In many cases these match makers worked along eugenic lines as, for instance, when the *Schadchen* was instrumental in bringing about the union of the daughter of a rich man with a budding scholar; or when he brought together well-known families from distant towns for the purpose of uniting their children in matrimony. But, on the whole, a great proportion of physical and mental defectives among the Jews of today owe their existence to his nefarious activities. Inasmuch as he was legally entitled to compensation

for his troubles, he usually stopped at nothing in his attempts at doing business. Jewish folk-lore and literature abound in tales of unscrupulous marriage brokers who brought about marriages between defectives and cripples. In Zangwill's *Children of the Ghetto* we find an excellent pen picture of the *Schadchen*, and many of the novels of Jewish life in Russian, German and Yiddish contain splendid types of this Jewish marriage broker. On the Yiddish stage he is very frequently portrayed in his true color. In eastern Europe he is as active at present as he ever was, and among the Jewish immigrants in London, New York, Philadelphia, Chicago, etc., he is still doing excellent business. Even among the rich, prosperous and ostensibly assimilated Jews in Berlin, Vienna and Paris, he is now quite often called into service by fathers of marriageable daughters, and by men who are willing to enter a matrimonial alliance with any woman who has money, or is likely to inherit it. This may be one of the important reasons why the proportion of defectives among the rich Jews of Germany is still higher than among the Christians in that country.

EFFECT OF CHARITY

Jewish charity, proverbially a model which others ought to follow, has no doubt been of great value to those who were in need of help from their fellowmen, expecially during the great calamities which often befell the Jews during medieval days, such as massacres, lootings of Jewish quarters, or expulsions which were so frequent during the Middle Ages and have not ceased during the twentieth century in Russia and Rumania. But during peaceful and especially prosperous times, this Jewish philanthropy has been an important dysgenic factor and is undoubtedly responsible in a large measure for much of the degeneracy observed among the Jews of today.

In medieval times, when charity and philanthropy were practically unknown among the Christians in Europe, excepting the little done by the Catholic Church, the Jews were just as active in the field of relief of the poor, the sick and the defectives as they are at present. In the treasury of information of Ghetto life, *Jewish Life in the Middle Ages*, by Israel Abrahams, we find enumerated the various agencies which were active in relieving poverty and pauperism. In the Ghetto of Rome there were so many philanthropic societies that their enumeration occupies several pages of Abrahams' book. They were all active in treating the sick, helping the defectives and incidentally encouraging the parenthood of those who, because of physical or mental infirmity, could not help themselves.

Modern organized charity has made an attempt to work along prophylactic lines, but, as far as I have observed, Jewish philanthropic agencies have not worked very assiduously along eugenic lines. In many Jewish communities in eastern Europe, and in some even in western Europe, there are found societies whose object is marrying every Jew and Jewess, irrespective of his or her physical or mental state. The itinerant Jewish beggar and mendicant, known as the *Schnorrer*, of whom Zangwill gave us such an excellent picture in one of his works, often begs for a dowry for his daughters. Things reached such a stage that many who had no marriageable daughters begged for alleged ones, and at present many carry with them certificates from the rabbi, or the head of the congregation of their community, to the effect that the bearer has one or more marriageable daughters who need dowry if they are to be saved from celibacy. As I stated already, in eastern Europe there are even at present societies for just this purpose.

As far as I know, we have no such societies in New York City, but I have known the case of a philanthropically inclined lady, in fact a director of a highly organized charity society, who spent several hundred dollars uniting two cripples into matrimony, and the newly wedded wife soon conceived and gave birth to a defective child, which she brought to the society asking for an increase in the allowance given her as a "pension." On the whole, the Jewish charitable agencies in Vienna, Berlin,

London, and especially New York at present, keep on supporting all the defectives, reckless and degenerate in their communities. In New York they are even "pensioned" so that they may at ease keep on proliferating at a rate which is appalling when it is considered that many of their children have physical or mental defects, and will, when reaching maturity, present grave social problems to the community.

I have already mentioned that the average age at marriage appears now to be higher among the Jews than among others. The reason is that they are mainly city dwellers, and their occupations require long years of preparation before fitting the person to earn a livelihood. The thoughtful, the intelligent and those endowed with foresight are not in haste to marry. They realize that marriage entails important obligations which a man of character must feel confident that he is fit to fulfil. It is different with the pauper who is by nature reckless, often actually parasitic. Matrimony to him is not an important event and entails no obligations and he plunges into it, knowing that his offspring will be cared for by charitably inclined persons or societies.

The Biblical prediction that the poor shall always be among the Children of Israel is thus more than fulfilled. In spite of their industry, frugality, thrift, sobriety and even philanthropy that aims at abolishing pauperism, there are more Jewish mendicants, paupers, dependents and defectives than social conditions would lead us to expect.

BIRTH RATE NOW FALLING

The deleterious influence of these dysgenic customs and habits of the Ghetto is proved in another way. In western Europe and in America, where the native Jews have discarded more or less these peculiar marriage customs, and where marriage is postponed till the contracting parties are prepared for the responsibilities they undertake; where the activities of the *Schadchen* are restricted or altogether spurned; and where the physical condition of the man counts for as much as his intellectual capacity, there has been observed a very decided and striking change in the physical and intellectual peculiarities of the people whose parents and grandparents have been inhabitants of the Ghetto. Their birth rates are low and are sinking; in fact, according to reliable statistical evidence available, the birth rates of the Jews in the large cities in central and western Europe are lower than those of any other religious group of people. Going hand-in-hand with this is also noted a striking improvement in their social and economic conditions. There are hardly any dependents, mendicants and paupers of Jewish faith whose parents have lived outside of the Ghetto in Germany, France, England, Italy, Scandinavia or the United States for two or more generations. Practically the Jewish dependents in western countries are of eastern nativity. But the proportion of physical and mental defectives has not been materially reduced among them, which is evidently one of the hereditary traits which cannot be easily eradicated.

While the economic conditions of the native western Jews are on the whole superior to those seen among their eastern co-religionists, this cannot be said about some other peculiarities which may be noted by a close observer. The well-known Jewish *Schnorrer* and itinerant mendicant has disappeared among them. But instead we find him now as a tramp or vagrant who does not at all differ from the non-Jewish people of this class. But this sort of vicious person, while parasitic and anti-social during his own life time, does not menace future generations as a rule, because he hardly leaves any progeny. It is from among these that we recently observed many of the Jews who are vicious, especially the drunkards, drug fiends, etc. They are now met with among the Jews in the United States. Had they remained under the influences of Ghetto life, they would undoubtedly have contributed to the dependent class and proliferated in the characteristic manner described above.

Another important change has taken

place among the Jews who have assimilated in western countries. They do not cultivate, nor do they support learning, scholarship and the arts to the same extent as they did in past generations. It can no more be said that the arts and sciences are their ideals; their aims appear to be more material, if not altogether sordid. In the United States Jewish philanthropy is very active in the direction of helping the poor and helpless and incidentally the pauper, the shiftless, the defective and the degenerate. But it is a striking fact that they make no effort in the direction of encouraging the exceptionally able or promising; there is no Jewish society to help the exceptionally bright, the talented and the promising among the Jewish youth in this city. In fact, the fund formerly available for such purposes has for some reason been diverted in other directions. I shall not enter into details about the ideals of marriage among the prosperous Jews in this city. All I shall mention is that marriage with a scholar is not given preference by rich parents, as was the case with their ancestors, but they look out for the possession of worldly goods by prospective husbands for their daughters.

The result is that while we have many prosperous and rich Jews in this country, there are very few *savants* whose ancestors have lived in the United States for two or more generations. Nearly all the workers in the fields of literature, arts and sciences, of Jewish faith or origin, were born in Europe, and even the great rabbis are not natives of the United States. This may be attributed in a great measure to the changes in the ideals of marriage which have taken place among the Jews in the United States during the last two or three generations. On the other hand, the intensive philanthropy, to which they still adhere, assures the perpetuation of many strains which are undesirable, to say the least.

From what I know of conditions in western Europe, it appears to me that they are drifting in the same direction. While among the Jews the support of the arts, literature and sciences is, on the whole, much more evident and substantial than among the Christians of the same social and economic status, it is not along eugenic lines, not having the tendency to improve the inborn qualities of future generations by the encouragement of marriage and parenthood of the intellectually superior. On the other hand, because they no more adhere to certain ordinances and superstitions about marriage, they no more encourage the marriage and parenthood of the physically and mentally strains to the extent their ancestors did. We may, therefore, expect that the number of defective Jews will in the near future not be higher among them than is found among the peoples around them.

CONCLUSION

I believe I have proved in this article that the extraordinary number of exceptionally capable and talented Jews, as well as the excessive number of physical and mental defective among them, owe their origin to a great extent to special and peculiar selective agencies. Their marriage laws and customs were effective in securing the augmentation of the favored stock, in increasing the number of individuals who are inherently above average in mental, intellectual and moral qualities. Giving preference in marriage to the scholar, encouraging him in his efforts, and often endowing him, the Jews have followed sane ideals in respect to marriage and procreation of favored stock. But some features of Jewish life, habits and customs have also been effective in enhancing the multiplication of the physically and mentally defective, and as a result we have at present an excessive number of persons who are of inferior stock among them. Especially must be emphasized their methods of distributing relief to the poor and afflicted as a dysgenic agency, responsible for a considerable proportion of the failures encountered among the modern Jews. However, with the recent adaptation of the mode of life, habits and customs of their non-Jewish neighbors, these peculiarities are gradually being effaced. Whether the loss thus sustained in the number of capable Jews is compensated by the decrease in the number of defectives depends on the point of view.

MULTIPLE BUTTON-BALLS

R. W. SHUFELDT, *Washington, D. C.*

ON PAGE 146 of the March, 1917, issue of *American Forestry*, I published a brief article on the "Sycamore or Buttonwood Tree Flower." It was illustrated by a cut showing that, in certain instances, there may be a short-peduncled flower-head or ball springing from one of the twigs of the tree, with another hanging below this, its peduncle being somewhat longer and apparently pressed into the upper ball at its proxi al end. At the time this was published, I considered the condition rare, and so stated in my article. It caused many people to look up into the sycamores or plane trees, to ascertain if other specimens could be obtained. These were not long in coming. A specimen was sent me that had four balls to a string, the latter being formed by the peduncles in a straight line, the flower-heads or balls averaging about an inch apart. This specimen I published, with a brief account in the JOURNAL OF HEREDITY (July, 1917, p. 310), and this article brought me a good many more letters from correspondents who had observed similar strings of these flower-heads.

Then there was a lull in the correspondence which was rapidly showing me up as being a person who but rarely gazed heavenward—this at least being the case when I was either under or in the neighborhood of a plane tree. However this may be, the charge was to be brought home with still greater emphasis a little later on—indeed, it was not long on the way. The next surprise along this line of observation was handed me by Prof. Ralph L. Johnson, of Girard College, Philadelphia. During September, 1917, Professor Johnson sent down to me a box of button-balls, whereon the united peduncles exhibited all the way from *three* to *seven* to a string. These balls were very large, dark colored, and firm, and they certainly presented a most remarkable sight. Many of them were over an inch in diameter; in some cases they were side by side on the common string, and in one or two instances there were three balls with peduncles so short that the group were mutually tangent to each other. I made a number of negatives of these interesting specimens, one of which is reproduced here to illustrate the present article.

Professor Johnson has kindly given me permission to publish his two very interesting letters on this subject, they being dated September 17, 1917, and September 25, 1917, respectively; they are reproduced in this order below.

A TANDEM OF SEVEN

Girard College,
Philadelphia, Pa.,
Sept. 17, 1917.

Dr. R. W. SHUFELDT,
Washington, D. C.
SIR:

After reading your article in the July JOURNAL OF HEREDITY, Vol. xviii, Page 310, I examined the sycamore trees in Delaware Co., Pa., and find tandems of four, five, six and one of seven button-balls.

Under separate cover I have sent you a tandem of four and of *six* respectively on the same stem within three inches.

There is hanging in my study a spray with a peduncle with *six* balls, one of three, and two of four balls, all within seven inches upon the same branch. I have also a *peduncle* with *seven* button-balls; this I gathered from a six-foot step ladder. On another branch within two inches there is a tandem of *six* and another of *four* balls. I have gathered three peduncles of *five* balls.

The tree is about eight inches in diameter and forty feet high. It perhaps came from the West Chester Nursery. It is growing beside a much used road, in the center of a suburb of West Philadelphia. There are wonderful clusters of button-balls on this tree, often a score upon a branch no thicker than a small pencil.

Kindly advise if you wish any further facts or service. I have not examined the tree minutely—only from a six-foot ladder. There may be larger tandems than seven.

Yours most truly,
(Signed) RALPH L. JOHNSON.

SOME REMARKABLE STRINGS OF BUTTON-BALLS

The sycamore *Platanus occidentalis* or, as it should be called, plane-tree in America usually bears single flower heads popularly called button-balls. Investigation by members of the American Genetic Association has brought to light strings of them containing as many as seven. Professor Augustine Henry, the distinguished British authority on trees, suggests that these trees may be hybrids between *Platanus occidentalis* and *P. acerifolia*. Photograph (considerably reduced) by R. W. Shufeldt. (Fig. 6.)

Girard College,
Philadelphia, Pa.,
Sept. 25, 1917.

Dr. R. W. SHUFELDT,
3356 Eighteenth Street,
Washington, D. C.

DEAR SIR:

Your letter of Sept. 19th has caused me to send by separate package a collection of "tandems." These were selected Sept. 25, 1917, from the same tree described in my letter of Sept. 17, 1917.

While there are many plane trees here about, I have not noticed the multiple balls on any others. This tree, described in my former letter, is so full of balls that from the ground one is lead to believe that dozens are in a cluster.

On a spray twelve inches long you will find thirty balls arranged upon respective peduncles as follows, proceeding toward the tip of the branch: 3 - 3 - 5 - 5 - 4 - 5; also within four inches 4 - 7 - 5 or a total of sixteen balls; then within seven inches on another 4 - 5 - 5 - 6; and again within the same distance 4 - 5 - 6 - 5; then a peduncle with 4 balls beside one with seven balls; a tandem of five and a tandem of seven. This shows the balls grow odd and even to a respective peduncle.

Yours truly,
(Signed) RALPH L. JOHNSON.

I have requested Professor Johnson to obtain the history of this tree, if possible, and I trust he will succeed in doing so.

Should any reader of this article be so fortunate as to meet with a "tandem of eight balls," I would certainly like to hear of it. Seven on a string is the largest up to date.

Babies Not Banished from Washington Apartment Houses

Apartment houses are poor places in which to bring up children, but many children in large cities must be brought up in them, or not at all. The rule made by some apartment house managers, not to rent apartments to families with small children, is dangerous to eugenics, as encouraging childless families in a superior part of the population. It is therefore of importance to know how far such limitations are enforced.

The JOURNAL OF HEREDITY has investigated the policy of forty of the important houses of Washington. It is gratifying to find that thirty-nine of them do not object to children. As the demand for apartments in Washington greatly exceeds the supply, at the present time, an apartment house owner could hardly suffer any pecuniary loss if he discriminated against families with children, for there are plenty of childless families who would fill up his building. The fact that there is no discrimination against children cannot, therefore, be laid to a fear of losing money.

Only in one case, and that a relatively small apartment house, was it stated that families with small children would be barred. The manager explained that the same tenants had occupied the building for many years; that all of them were childless; and that the accidental presence of a uniformly childless set of tenants had led to his decision not to permit any intruders who would mar the harmony. The rule had recently been broken in one instance, he admitted, when a long-time tenant had violated the conventions by giving birth to offspring; but in view of the many years in which she and her husband had occupied the apartment he did not protest or evict them.

At this apartment house dogs were barred as well as babies. Of the whole list, twenty-nine apartment houses made no objection to dogs, if they were properly cared for; eleven refused to allow them.

Inquiry was made as to whether baby carriages were obliged to use the freight elevator. This was found uniformly to be the case, except in a few small buildings where there was no separate freight elevator.

Owners and lessees of apartment houses in the District of Columbia are to be congratulated on their attitude. It would be interesting to have similar investigations made in other cities, particularly in New York city, where it is commonly supposed that there has been much discrimination against babies on the part of real estate men.

AMERICAN SYCAMORES ARE POSSIBLY HYBRIDS

August 3, 1917.

TO THE EDITOR OF THE JOURNAL OF HEREDITY:

I am much interested in the articles on "Remarkable Button-Balls" in your July issue, page 310. The American buttonwood (*Platanus occidentalis*), bears usually one fruit ball, smooth on the outer surface, as the styles break off. The introduced tree, much planted in American cities (just as it is in European towns and cities), is *Platanus acerifolia*. The London plane or maple-leaf plane has two or three balls on each string, which are prickly to look at, as the styles persist. The tree has never been found in the wild state; and it is erroneously called by nurserymen "oriental plane" in the United States, and "occidental plane" in Europe. It is neither one nor other; but it is intermediate between the two wild species. The true oriental plane (*Platanus orientalis*) is never planted in streets, either in Europe or in the United States. It has deeply cut leaves, and bears usually six balls on each string; they are very prickly. This tree is much less vigorous, and is difficult to strike from cuttings, while the London plane is struck from cuttings very readily.

The most remarkable fact is that related in the article on the button-ball of the Morris Nursery Co. that the (so called) "oriental plane" is the only kind grown in their nursery, as it is superior to the American species. Considering that the American Buttonwood is the tallest, finest, and most vigorous broad-leaf tree in forests of the United States, will any one explain how it degenerates when planted in American towns? Will any one explain how the native species is inferior to the imported one; and why the latter is preferred?

It is possible that the abnormal specimens of *P. occidentalis* with three or four balls to the string, may be hybrids, as both *P. occidentalis* and *P. acerifolia* are frequently planted near each other in American cities. I should be very pleased to see dried specimens or branches with foliage and fruit-balls attached from any tree of *P. occidentalis* bearing an abnormal number of balls to the string. Two balls have been recorded frequently; but three or four balls seem to be unknown in this species.

Yours truly,

AUGUSTINE HENRY.
Royal College of Science for Ireland, Dublin.

The Relation between Race and Culture

SOCIO-ANTHROPOMETRY, an interracial critique. By B. L. Stevenson, Ph. D. Pp. 153. Boston, Richard G. Badger, 194 Boylston Street, 1917.

One school of sociologists thinks the manners and customs of a people are to be interpreted in terms of its racial heredity. The Russian and German civilizations, for example, differ because the Russian people contain Mongol blood which is not found in the limits of the modern German empire. Dr. Stevenson believes such a method of study is not justified. She discusses the culture of various European nations, then describes their racial make-up, and points out in conclusion that correspondences between the two are not exact. Moreover, she declares that the attempt to draw correspondences is not legitimate, since the two studies, anthropology and sociology, deal with such different material in such different ways. The question to which her book is devoted is an important one, and although her contribution is not conclusive, it is well to have the matter presented frequently. Numerous tables which she prints, giving anthropometric data for the races of modern Europe, will be found convenient for reference. by students.

INTELLIGENCE OF IMMIGRANTS

Dr. H. H. Goddard Finds Indications That Large Part of Those Who Arrive in the Steerage are Feebleminded—Low Grade of Intelligence May Possibly Not Be Hereditary in This Case

THAT the average steerage immigrant has a low grade of intelligence—perhaps is even feebleminded—is the conclusion suggested by H. H. Goddard, director of research at the Training School, Vineland, N. J. Dr. Goddard and his assistants examined six small groups arriving at Ellis Island. Two of the groups—twenty Italians and nineteen Russians—were selected because they appeared to the investigator to be feebleminded. The other four groups were selected as being representative of their respective nationalities, and comprised 35 Jews, 22 Hungarians, 50 Italians and 45 Russians. In every case the immigration officers had previously culled out all whom they recognized as mental defectives. Very obviously high grade intelligent immigrants were also passed by. Those examined are probably a fair sample of the bulk of the steerage immigration.

Numerous tests were given. "Each test taken by itself seems to indicate a very high percentage of feeblemindedness. There is no exception to this." Little attempt is made by Dr. Goddard to establish the exact amount of feeblemindedness, because of uncertainty as to the proper standards to be used for scoring some of the tests. With the Binet scale, only two of 148 immigrants scored as high as twelve years, which is usually taken as the dividing line between feeblemindedness and normal intelligence in adults. When liberal allowances are made for every possible case where the scoring may be too high, it yet appears that more than half of these immigrants test feebleminded, and none shows superior intelligence. Dr. Goddard[1] discusses the results as follows:

"Doubtless the thought in every reader's mind is the same as in ours, that it is impossible that half of such a group of immigrants could be feebleminded, but we know that it is never wise to discard a scientific result because of its apparent absurdity. Many a scientific discovery has seemed at first glance absurd. We can only arrive at the truth by fairly and conscientiously analyzing the data.

"First it should be noted that the immigration of recent years is now longer representative of the respective races. It is admitted on all sides that we are now getting the poorest of each race. This makes them a highly selected group from the start. For example Salmon says of every 1,000 Polish immigrants all but 103 are laborers and servants.

"Of the twenty-two in the Jewish group who classify as feeble-minded, nineteen, or 60% of the whole, classify as morons. It will be recalled that the English College of Physicians define a moron (what they call feebleminded in the specific sense) as 'One who is capable of earning his living under favorable circumstances but is incapable from mental defect, existing from birth or from an early age, (*a*) of competing on equal terms with his normal fellows, or (*b*) of managing himself and his affairs with ordinary prudence.' We have now to ask the question, is it possible or reasonable that 40% of the immigrants in such groups as we have examined are morons according to this definition? Let us examine critically the definition, and bring to bear upon the problem what we know of the nature, character and work of this class of immigrants.

"First, the definition admits that they are capable of earning a living

[1] Goddard, Henry H. Mental Tests and the Immigrant. *Journal of Delinquency*, ii, pp. 243–278, Sept., 1917.

under favorable circumstances. Favorable circumstances may be construed to mean an opportunity to work at any possible kind of labor which will bring sufficient remuneration to supply food, clothing and home. It is easy to be seen that the kind of labor and the remuneration necessary for support will depend very largely upon the character of the living that is needed, that is to say, the amount and quality of food, the quality of clothing, and the kind of domicile. One familiar with the requirements of the average immigrant will not hesitate to admit that the conditions under which he is willing to live are so relatively simple that if he is willing to work at all it is not difficult for him to make a living.

"The second clause of the definition says that he is incapable ('because of mental defect,' etc.) of competing on equal terms with his normal fellows in the struggle for existence. Again a consideration of the immigrant's situation shows us that he, on the average, does not have what is meant in the definition by competition with his normal fellows. As a result of his early training, and the conditions under which he has lived in his own country he is willing to do work that no one else will do. There is therefore no competition, properly speaking.

"The last clause says that he is incapable of managing his own affairs with ordinary prudence. It is not at all impossible that it is literally true that the 40% do not manage their own affairs with ordinary prudence. In many cases the affairs are managed for them, as surely and thoroughly as for any group of dependents among us.

"We may look at the problem from another standpoint. The writer has already suggested that the problem of the care of morons might be solved if the public could be educated to recognize these people as morons, and to treat them with that care and consideration which their mental makeup requires. Morons as a class, if taken early and trained carefully and so kept from becoming vicious and criminal, could be successfully employed if the employer understood them, and realizing that they are children, excused their faults and mistakes, was watchful of, and patient with them.

TREATMENT OF IMMIGRANTS

"Now strangely enought it seems that this is exactly what we often do for the immigrant, not because he is a moron but because he does not know the customs of the country. He is excused because he does not understand the language. His every act and movement is more or less closely supervised because he is a foreigner. In a large percentage of the cases he goes at once, when he lands, to his own group. They protect and care for him, partly through racial pride, partly through common humanity, extending to him the care and oversight and patience which we have just mentioned. Contrast this with the intelligent, independent immigrant!

"There are no statistics available to prove or disprove the truth of these theories, but certainly it cannot be denied that this is literally true of a great many immigrants. It will doubtless be said by some reader that this is a libel upon the immigrant; that on the contrary he is a keen, sharp, energetic worker; that much of our population has been immigrant. It seems hardly necessary to suggest in reply that we are only speaking of 40% of the immigrants and that, too, of the immigrants who come in the steerage, whereas many immigrants come second class or even first, and that those who make a success and become prosperous citizens are the ones we most often meet, whereas the great mass are entirely beyond the ken of the average citizen. He knows nothing of them or how they live.[2] It may be but proper to add also that very few people realize what the moron is. To many people it is a simple formula; moron means feeble-minded, feeble-

[2] For the difference between the "old immigration" and the "new immigration" which commenced just after the Spanish-American War, consult Salmon, Thomas W. "Immigration and the Mixture of Races in Relation to the Mental Health of the Nation," Chapter vi of White & Jelliffe, *Modern Treatment of Nervous and Mental Diseases.* Philadelphia, 1913.

minded means imbecile or idiot as is known in the community. This is not the fact. The moron is a person of mental level of from 8 to perhaps 12 years. He is capable of earning a living under favorable circumstances. He many times gets along in the community because someone looks after him and manages his affairs for him, and sees to it that the competition with others of the community is not too severe for him. It must be understood that we are not claiming that we have proved that 40% of these immigrants are morons, but we do feel that the foregoing consideration to a considerable extent removes the absurdity which stood in our way of accepting as fact that a surprisingly large percentage of immigrants are of relatively low mentality."

THE PROBLEM OF HEREDITY

What of the eugenic aspect? "Morons beget mornons, and while these people themselves, as we have already said, have been trained in their own country through the vicissitudes of their life and environment so that they are fairly safe people in our community, yet when they marry and have children the case may be entirely different."

"Here then is a vital question which obviously our investigation does not answer. Are these immigrants of low mentality cases of hereditary defect or cases of apparent mental defect by deprivation?" There are no data on the point, but Dr. Goddard thinks that to a considerable extent the second explanation may hold good. "To mention only two considerations: First, we know their environment has been poor. It seems able to account for the result. Second, this kind of immigration has been going on for twenty years. If the condition were due to hereditary feeblemindedness we should properly expect a noticeable increase in the proportion of feebleminded of foreign ancestry. This is not the case." While the low intelligence of immigrants is not a cause for national rejoicing, it may therefore be less dangerous racially than it appears at first sight.

No Meeting of the Association to be Held This Year

Although there will be no meeting of the American Genetic Association this year, for the presentation of papers, members of the A. G. A. will find much to interest them in the programs offered by other societies during the holiday meetings in Pittsburgh. The Botanical Society of America will place the genetical papers of its program on Monday morning, December 31, and in the afternoon will present an invitation program including the address of the retiring president of the Society, Professor R. A. Harper, of Columbia University, an address entitled "Plant Breeding for Disease Resistance," by Dr. W. A. Orton, of the Bureau of Plant Industry, and an address on "Homoplasy and Longevity," by Dr. G. R. Wieland, of Yale University. Thus the entire program of Monday will be of great interest to geneticists generally. Plant breeders, members of the A. G. A., but not of the Botanical Society of America, may present papers at the morning session if introduced by a member of the latter society. Any member of the Plant Breeding Committee of the A. G. A. will be glad to arrange for the presentation of papers. The program of the American Society of Naturalists includes a group of invitation papers in genetics on Tuesday morning, and in the afternoon a symposium on "Factors of Organic Evolution."

AN AVOCADO MONSTROSITY

Robert W. Hodgson
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With the rapid extension of avocado planting in California and the consequent demand for trees, nurserymen have had occasion to raise many thousands of seedlings during the last four or five years. Among such a large number naturally some abnormal forms have appeared such as albinos and dwarfs, and among others a few teratological monstrosities have been reported. The latter usually take the form of fasciation in which terminal nodes have become expanded, presenting a ridged, flat stem of greatly increased width upon which normal buds are borne. Among such peculiar forms none more striking has been reported than that pictured in Fig. 7 which was found in a lot of Grande seedlings in the University greenhouse. This particular case does not exhibit the usual characteristics of fasciation and seems worthy of being put on record.

The peculiar growth was first noticed when the seedling was about seven months old and is still present. Although the first leaves were shed some time ago, the new growth exhibits the same peculiarity. The malformation consists of the hypertrophy of the terminal cluster of leaves together with several adjacent nodes. The leaves are markedly modified both in form, size, and consistency. The size is greatly reduced, and the terminal node is so shortened that the leaves are crowded together much as in the case of a brussels sprout. The consistency and form of the leaves are so modified that the general appearance is that of a much corrugated, imbricated mass of white fleshy tissue possessing a shiny surface.

Very careful examination revealed no traces of the presence of insects or of wounds caused by them. Microscopical examination has failed to show any indication of fungi. The general appearance of the modified leaves suggested a possible connection between them and the large fleshy cotyledons, but study has failed to confirm this. The cotyledon tissue was found to contain very large quantities of starch, some sugar, and notable amounts of oil. The abnormal tissue contained little of these but was fairly rich in protein. The cells of the cotyledon tissue were found to be heavy walled, larger, and in other ways distinctly different from the spongy pith-like, thin walled tissue of the modified leaves. Sections through such leaves showed that they lacked the palisade layer and spongy parenchyma entirely and possessed but a rudimentary vascular system. A few cells containing chloroplastids were found scattered here and there.

The effect of the abnormality on the growth of the seedling has been such that a shoot from a node further down has developed and has taken the ascendency. This fact together with the fact that all subsequent growth of the affected nodes has been of the abnormal type seems to indicate that the stimulus or change resulting in the peculiar growth has probably not been of a momentary nature such as the sting of an insect. To be sure, it may be possible that the abnormal tissue in this case is analagous to new forms which have been produced by the injection of certain chemicals into the ovaries of plants as established by Lloyd and MacDougal, but in this case the change has been purely somatic.

Examination of the literature does not discover much that is helpful in classifying this peculiarity and indicates that our present knowledge as to the cause of teratological forms is quite unsatisfactory. Thorough study of such forms might help unravel the mystery concerning the causes leading up to bud-mutations.

PECULIAR GROWTH ON AVOCADO SEEDLING

This peculiar growth appeared on a Grande seedling seven months after planting. All the subsequent growth of the infected nodes has been of the same nature. No traces of insect injury or fungus parasites have been found. What has caused this change? May it not be of the same nature which results in a bud-mutation? (Fig. 7.)

A BOTTLE-NECKED LEMON

Leonhardt Swingle, *Riverside, Cal.*

THE work of A. D. Shamel on bud sports and their occurrence in the citrus family has directed much attention recently to this class of variation. It is now recognized that such sports are more frequent and are of greater importance from the standpoint of improving and standardizing varieties than has been recognized before this time. A slight examination of almost any citrus orchard will usually disclose many cases of sporting limbs and demonstrate the need of further investigations on this subject.

The writer recently found in a Eureka lemon orchard near Corona, Cal., a tree bearing a large and very unusual limb sport. This branch has been overlooked in pruning until at the present time it comprises a large part of the tree. The whole limb is of a peculiar type as shown by the fruit, leaves, and habit of growth. It is very different from the remainder of the tree, which is to all appearances a normal Eureka lemon.

The fruit, as shown by the accompanying illustration, is at once distinguished by its long, bottle-like neck and its small size. It is a lemon but with the shape of a gourd. The limb is sufficiently productive, if the crop it now bears can be taken as a criterion, but lemons of this peculiar gourd-like shape are not worth much in the market today. This large limb and its crop of worthless lemons may be considered as so much detriment to the tree for it is occupying space and using plant food that might as well be used in the production of good fruit. The limb is a boarder instead of a producer.

As brought out in the illustration, the leaves of this limb are very different from those of the normal Eureka lemon. They are narrow and sharply pointed, resembling willow or peach leaves more than those of the remainder of the tree. These narrow leaves give a distinctive appearance to the side of the tree where this limb is located, although this difference in appearance is emphasized by the more slender and dense twig growth.

The narrow pointed leaves and "bottle-neck" fruit constitute a distinct and unusual type. There is no transition between the normal part of the tree and the sporting branch. There is a small twig on the sporting limb near its base, that bears normal Eureka lemons, while a short distance above is another twig bearing the "bottle-neck" fruit. Somewhere between the two twigs the change occurred from the normal to the freakish fruit.

The discovery of this limb encouraged the writer to make a search for others of a similar nature on other trees of the same grove. Several have been found varying in degree from large limbs similar to that described, to mere twigs.

It is interesting to note that there is an apparent correlation between the "bottle-neck" fruit and the narrow, pointed leaves. Where the leaves are narrow and pointed, the fruit is usually of this pronounced "bottle-neck" shape. This apparent relationship indicates that the value of a branch might sometimes be judged by its leaves, when pruning or cutting buds.

The discovery of such limb sports while still twigs makes it possible to cut them out before they reach a large size and lower the value of the trees by their production of worthless fruit. It is, of course, best to grow only trees which do not produce such freakish limbs. The next best thing is to keep such limb variations in trees under control by cutting them out with the pruning knife so that their erratic tendencies may be checked so far as possible.

BOTTLE-NECKED AND ORDINARY EUREKA LEMONS

A limb-sport was found in a lemon tree, which gave rise to lemons of the peculiar shape shown at the top of the photograph. The effect of the change was not confined to the fruit, but extended also to the leaves, which are much narrower than ordinary. Normal fruit and leaves, borne by the unchanged part of tree, are shown at the bottom of the photograph. The marked change in leaves and fruit is a good illustration of the fact that variability is *correlated*, and that one part of an organism cannot be markedly changed without producing changes in various other parts. (Fig. 8.)

The Number of Unmarried Persons in the United States

There are 17,000,000 celibates in the United States, according to a statement which has been going the rounds of the press, after originating in a magazine article on the sex question. Examination of the census schedules for 1910 indicates that this figure includes all males over 20 and all females over 15. A calculation based on such age limits is misleading, but the actual facts are quite striking enough. Persons 35 years of age or over are relatively unlikely to marry, and it seems fair to base computations on that age. They show, then, that there are nearly 2,000,000 unmarried men in the population, and about 1,250,000 unmarried women. There are about 1,500,000 unmarried women between the ages of 25 and 34, and a considerable part of these are certain never to marry. The celibacy of these millions is, from a eugenic point of view, not wholly to be deplored. While the number includes many potential fathers and mothers of a desirable character it is probable that, on the whole, these life-long celibates are eugenically inferior to the married population.

Pure-lines of Bacteria

From studies of bacteria, L. J. Cole and W. H. Wright conclude that descendants of a single cell constitute a pure-line, which cannot be modified by selection. Mutations occur in such lines, both spontaneously and in response to external stimulus. Much of the variation in bacterial cultures is attributable to isolation and perpetuation of certain pure-lines and the elimination of others. The study is reported in *Jour. Infect. Diseases*, 19, pp. 209–221.

COLOR INHERITANCE IN MAMMALS

VII, The Horse—Studbooks Have Afforded Data for Many Investigators—Many Different Pairs of Allelomorphs to be Found in All Combinations —Some Interesting Cases in Hybrids

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HURST[1] showed as early as 1906 that chestnut differs from the darker colors by a simple Mendelian recessive and this result has been confirmed by all later workers. Most of the remaining factors were rapidly worked out by Wilson,[2] Sturtevant,[3] Anderson,[4] Wentworth,[5] and others with results largely in harmony. There still exists, however, one very important difference of opinion. Most of the factors were worked out simply in opposed pairs of characters and little attention has been paid to the relations of the different pairs to each other. Two different theories as to these relations have arisen. The present paper follows in the main the view very clearly presented by Wentworth and probably most generally held, viz., that there are many different pairs of allelomorphs which may be found in all combinations. Wilson,[6] on the other hand, holds that most of the factors belong to the same series of allelomorphs. Thus he considers gray, dun, bay, black and chestnut to be such a series of what he calls polygamous factors. This series is of a very different kind from the nine sets of multiple allelomorphs known among rodents. In the latter, the factors produce a graded series of effects when arranged in the order of dominance, a fact which suggests that in these cases we are simply dealing with different levels of potency of some one genetic as well as physiological factor. Wilson's series cannot possibly be arranged in such a way. It is difficult to conceive how variations in one physiological factor could produce such diverse effects. The series, may, indeed, be compared with Nabour's[7] series of color mutation in grasshoppers and perhaps with the condition of complete linkage found in factors of the same chromosome in the male *Drosophila*,[8] or the female silkworm.[9] If Wilson's hypothesis is correct, it is easiest to suppose that the factors are related merely in a mechanical manner in the germ-cells and not as variations of the same factor.

BAY-HORSE—GRAYMAB

$1a_1$	G, g	G—gray
	R, r	R—roan
$1a_2$	V, v	V—piebald
$1a_3$	—	
1b	D, d	D—dun
—	M, m	hhmm—sorrel
$2a_1$	A, a	a—black
$2a_2$	—	
$2a_3$	—	
2b	B, b	b—chestnut

Classification explained in paper on the mouse, JOURNAL OF HEREDITY, 8:373, August, 1917.

FACTORS APPEAR INDEPENDENT

However, there is considerable evidence in the horse which appears to the writer to favor decidedly the hypoth-

[1] Hurst, C. C. 1906. *Proc. Roy Soc.*, 77:388.
[2] Wilson, J. 1910. *Sci. Proc. Dub. Soc.*, 12:331.
[3] Sturtevant, A. H. 1910. *Biol. Bull.*, 19:204; 1912. *Jour. Gen.* 2:41.
[4] Anderson, W. S. 1913-1914. *Amer. Nat.*, 47; *Ky. Sta. Bull.*, 180:121.
[5] Wentworth, E. N. 1914. *Zeit. f. Absl. u. Ver.*, 11:10.
[6] Wilson, J. 1916. A Manual of Mendelism. 152 pp.
[7] Nabours, R. K. 1914. *Jour. Gen.*, 3.
[8] Morgan, Sturtevant, Muller and Bridges, 1915. The Mechanism of Mendelian Heredity.
[9] Tanaka, Y. 1914. *Trans. Sapporo Nat. Hist. Soc.* 5.

esis of independent factors instead of complete linkage. There are first certain considerations based merely on appearances. Wilson himself grants that roan is inherited independently of the others, on the ground that the roan pattern obviously can be combined with any of them in effect. Bay, blue and strawberry roans are all common, and Wilson mentions roans which later turn gray. Doubtless he would consider piebald as due to an independent factor for a similar reason.

But it is also well known that grays may be any color at birth, and also in duns, varieties are recognized which appear to be the dilute forms of bays, blacks and chestnuts respectively. These are the dark-maned duns, the mouse-colored horses and the creams. Even among chestnuts, differences homologous to that between bay and black may be visible in the red and liver-colored chestnuts, though this does not appear to have been tested genetically.

The genetic evidence for the theory of independence is thoroughly satisfactory in regard to the factor which changes bay to black (A,a), and that by which chestnut, differs from either (B,b). In breeds in which bay is more common than black more chestnuts should possess factor A than a and chestnut by black, both recessive to bay, should yet produce many bays, each parent supplying the dominant factor which the other lacks. This turns out to be the case. Thus Anderson found 111 chestnuts, 83 blacks, 20 browns (generally equivalent to dark bay) and 124 bays from chestnut by black among Kentucky saddle horses. In these quite extensive results 42% of the offspring are inexplicable on Wilson's theory under which neither blacks nor chestnuts could ever possess the dominant bay factor.

In the case of gray or dun it is more difficult to get conclusive evidence, as it is necessary to find individual gray or dun sires which showed themselves to be double heterozygotes in particular kinds of matings. Gray and dun are not among the commonest colors in most breeds and stud books, moreover, are known to be none too accurate in regard to colors, so that individual cases must be used with caution. Wilson[10] gives the record of twenty gray Thoroughbreds which had at least one chestnut foal from a chestnut mare and were therefore GC on his hypothesis. These stallions produced from chestnut mares 94 grays, 15 bays, 1 black and 61 chestnuts. The presence of so many bays and one black can hardly be ascribed to errors although it must be admitted that they are not as numerous as one would expect on the hypothesis of independence. The sire which seems most certainly to be a double heterozygote, GgBb, is Gray Frairs, with 15 grays, 3 bays and 4 chestnuts from chestnut dams. Possibly partial linkage between G and H may exist. In this case, most grays which produce chestnuts at all would be of formula GBgb and so produce an excess of chestnuts. At any rate it seems clear that gray can transmit both chestnut and bay.

GRAY, ROAN AND PIEBALD

Turning to the list of factors, it may be said that the factor for gray has been certainly demonstrated. A number of gray stallions are known which are homozygous, producing only grays from mares of all colors. Most grays are naturally heterozygous and produce very close to the expected 50% gray, 50% of other colors, when mated with other colors. Factor G has been placed in class $1a_1$ as a dominant factor which inhibits color regardless of its quality, but its mode of action is peculiar. Grays generally show little or no white when born, but gradually become whiter as they grow older, white appearing early especially on the head.

The dominant factor for roan has also been clearly demonstrated, both homozygotes and heterozygotes being known. It is more typical of class $1a_1$ than is the factor for gray. The mixing of white hairs with colored ones occurs regardless of the color of the latter. The head and lower limbs are usually

[10] Wilson, J. 1916. *Loc. cit.*

not much affected, while the rest of the coat shows an even mixture free from the dappling of grays. There is no change with age. The relations of gray and roan have not been thoroughly cleared up. Wentworth has given data which show that roans may transmit gray but that grays cannot transmit roan. That is, horses of formula GgRr are roans in the stud book. *A priori* this seems a very remarkable result. It appears to mean that the gray factor which whitens animals which would otherwise be solid colored is somehow inhibited in the presence of another factor with a whitening effect. The explanation, however, is probably, as Wilson suggests, that the real distinction between roans and grays is not generally recognized. A horse which is born chestnut and turns gray is called a gray, but one born a chestnut roan is called a roan even though it later becomes white, the latter effect being looked upon as associated with the roan effect in such cases. Thus roans should probably be divided into two classes, those which hold their color (ggRr) and those which become gray (GgRr).

Mendelian inheritance has been clearly established in the case of the pattern of skewbald and piebald horses. The pattern appears to be quite similar to the piebald patterns of rodents in character and so is classed with them here in class $1a_1$. It is, however, a dominant. Self by self, seems to give only self (except for small markings), while pied by self was found in a tabulation by Walther[11] to give 109 pied to 115 self. This ratio indicates as one would expect that practically all piebalds are heterozygous. Solid white horses are occasionally found, the white sometimes even invading the eyes. Possibly these may be homozygous for the piebald factor.

Horses with white markings on head and feet are very common but do not have the piebald factor. Walther could find no simple mode of inheritance. They seem to be comparable with the Irish rats which Hurst found to be free from the hooding factor.

Bay is agreed by all writers to be a simple dominant over black. A dominant inhibitor of black is involved which can best be compared with the agouti factors of the rodents and is therefore put in class $2a_1$.

Brown is a color which has caused much trouble. Sturtevant believed that browns were generally heterozygotes between black and bay. Anderson considers it to be a composite term at least among saddle horses, including two distinct varieties genetically, dark bays and rusty blacks. Most browns appear to have the bay factor.

The factor by which chestnuts of all shades differ from blacks and bays is somewhat difficult to classify. An ordinary chestnut shows little but red and might be compared with the recessive red of guinea-pigs. But liver chestnuts show a larger amount of dark pigment which, however, is brown, not black. Thus the factor may well be placed in class 2b with the chocolate factor of rodents. Appearances suggest that livers differ from ordinary chestnuts in the same way that blacks do from bays, *i. e.*, in having factor a in place of A, but the writer knows of no data which bear on this point.

GRADES OF INTENSITY

There are many grades of intensity in horses, especially noticeable in chestnuts, which remain to be analyzed. A dominant general dilution factor by which buckskin duns, mouse-colored horses and creams differ from bays, blacks and chestnuts seems best established. Although dominant, it is put for the present in class 1b, the factors of which it most resembles in effect. Besides this, Wentworth has shown that there is a recessive factor which is responsible for the difference between light-maned sorrels and those with dark manes, a result which has been confirmed by McCann.[12] Light-maned liver chestnuts which seem to have this factor are not uncommon. It may also

[11] Walther, Ad. 1913. *Zeit. f. Abst. u. Ver.* 10:1.
[12] McCann, L. P. Journal of Heredity, 7: 370–372.

be put in class 1b, but so far its effect in bays and blacks has not been worked out.

COLOR INHERITANCE IN HORSE HYBRIDS

There are a number of curious facts in connection with horse hybrids which need more investigation. Gray and piebald remain dominant in crosses between horses and asses. In a cross made by Ewart[13] between a zebra and piebald mare the hybrid showed no trace of the piebald pattern, but the dam may have been a heterozygous piebald. It is often held that dun is the ancestral color of the horse, the wild Przevalski horse showing an approach to this color. Zebras also show a pale cream ground color with black stripes and would be expected to have factor D. Nevertheless, when crossed with chestnut, black, or bay horses, the offspring approach bay rather than dun. If the zebras contain the same factor as dun horses, dominance is reversed. Finally, another apparent reversal of dominance must apparently take place in the production of chestnut mules, as anything like this color is unknown in donkeys and factor b is recessive in horses.

Effects of Factor Combinations

	gr	gR	Gr	GR
DAB	Dun	Dun roan	Gray	Gray (born roan)
DaB	Mouse	Mouse roan	Gray	Gray (born roan)
DAb	Cream	Cream roan	Gray	Gray (born roan)
Dab	Cream	Cream roan	Gray	Gray (born roan)
dAB	Bay	Bay roan	Gray	Gray (born roan)
daB	Black	Blue roan	Gray	Gray (born roan)
dAb	Chestnut	Strawberry roan	Gray	Gray (born roan)
dab	Chestnut (liver?)	Strawberry roan	Gray	Gray (born roan)

The Occurrence of Seven-Leaved Clover Leaves

Apropos of De Vries' achievement in producing a seven-leaved clover by breeding from a four-leaved strain, sometimes cited as proof of the cumulative effect of selection, I wish to say that I at one time found in the field a plant which closely resembled De Vries' production, it having one leaf with seven leaflets, one with six, a goodly number of fives, and the remainder nearly all four-leaved. There were only a few normal leaves on the plant.

This would seem to place De Vries' achievement on a par with that of Luther Burbank in producing a scarlet California poppy from a yellow one having a red stripe. According to W. J. Spillman, such scarlet poppies have been found growing wild, and Burbank's achievement might therefore be ascribed to the untangling of hereditary characters already in existence.

As this clover plant of which I speak was found in late autumn and had disappeared the following spring, no seed could be saved, and as my specimens were not preserved with sufficient care I now have nothing to show for it but an opinion that if the matter were made the subject of sufficiently wide inquiry, other such plants would be brought to light, this discovery being rendered probable by reason of the popular interest taken in four-leaved clovers.

H. D. Tennent,
McConnelsville, Ohio.

[13] Ewart, J. C. 1899. The Penycuik Experiments.

THE DUCHESS APPLE IMPROVED

Sport with Brilliant Red Color Appears to be Due to Bud Variation—Other Apple Varieties that Have Originated in a Similar Way[1]

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A STRIKING variation from the usual type of the Duchess apple has been found by William Bardwell in his orchard near Excelsior, Minn. Since variations so marked are relatively rare, a statement of its probable origin and the nature of its departure from the variety type will be of interest to horticulturists and geneticists.

Duchess[2] is an old and well-known variety, "being one of the four pioneers among Russian apples in America"—imported by the Massachusetts Horticultural Society about 1835. A comparison of the new type with it will be made only with reference to the principal fruit and tree characters in order to set forth clearly the nature of the sport.

In tree and leaf characters Duchess and the sport are identical. Both bloom and ripen at the same time. While their relative keeping qualities have not been experimentally tested in storage, judging from the general characters of the sport, there would probably be little, if any, difference. In such fruit characters as size, shape, cavity, basin, calyx lobes and stem, the sport runs parallel with Duchess. The russet markings of the cavity and the dots are similar in size and distribution to Duchess. The flesh characters are also quite similar, the sport being slightly less tart in flavor, if there is a difference, but both should be given the same rank as to quality. The core lines, core and seeds are so nearly alike as to be indistinguishable.

So much for the points of resem blance! The outstanding characteristic difference of the sport compared with Duchess is the deeper red and more solid color of the skin. The typical color of Duchess is a pale yellow background more or less covered with irregular dark red streaks overlying lighter irregular blotches. The deepest color of Duchess sometimes approaches a solid red, but in many localities this variety lacks color to a fault. The sport has the same yellow background and is covered with a solid, dark red color on exposed parts, shading at the apex into a lighter red overlaid with darker streaks. In some better colored specimens there is nearly a solid but quite thin purplish red color at the apex end. Apples of the sport not so well colored have the dark red streaks characteristic of well colored Duchess. The general appearance of the sport in a box pack is decidedly more red. Another point of economic importance is the slightly tougher skin of the sport, although the skin of both is, on the average, made up of three thick-walled cell layers before the larger pulp cells are reached. However, the skin of the sport is not so easily broken and as a result the fruit stands up better when baked.

Since the history of this variation is known only in part, what reason is there for speaking of it as a bud sport? The tree was purchased about fifteen years ago from a local nursery and was supposed to be Duchess since it came in a

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[1] Published with the approval of the Director as Paper No. 89 of the Journal series of the Minnesota Agricultural Experiment Station.

[2] While this variety should be called Oldenburg, according to the rules of the American Pomological Society, it is little known in the Northwest by this name.

RED SPORT OF THE DUCHESS APPLE

The Duchess (often called the Oldenburg) is one of the best known American apples. A variation with a much richer color than the original has appeared, and may be even more popular in many markets. The Duchess (above) and the red sport (below) are shown natural size in the illustration. (Fig. 9.)

bundle of that variety. All branches bear the highly colored fruit which makes it impossible to determine with certainty whether it is a sport. It was bought for a grafted tree but since there is no evidence of a graft union at the base as far as can be determined by external appearance when the dirt is thrown back as far down as the roots, this point cannot be definitely settled. The seed of Duchess is used, when available, by nurserymen, to obtain seedlings, so that it is possible that seedlings of Duchess, open or cross pollinated, were used for stock on this particular occasion. Its origin as a seedling, however, presupposes that if a graft was placed on this particular stock it did not grow. The lack of vigor characteristic of most self-fertilized seedlings is not apparent in this case. So it appears that if this new type is a seedling it is so remarkably near Duchess in so many characters that it may be regarded as a combination of rare occurrence.

RETAINS CHARACTER WHEN GRAFTED

If this new form is not a seedling, the other possible method of origin is as a bud variation. If this new form originated as a bud variation it may be that this is the only tree of its kind, or others may have been grafted from the same source, providing there was sufficient growth from the original bud which varied. When topworked the sport retains its original characteristics.

If this is a bud sport from Duchess it is a good illustration of a variety being improved by this means. If it is a seedling this does not detract from its value. By carefully watching all varieties for such variations it may be possible to have different types within the variety which may vary in important features. The higher color of this sport over Duchess—certainly its nearest relative if not its parent—will make it a favorite in that class of trade where higher color is desired.

Sports similar to this have been of relatively frequent occurrence in the apple. A single limb, but not so highly colored as the Bardwell sport, was found on a Duchess tree in the University of Minnesota Experiment Station. Collamer arose as a sport from the Twenty Ounce, and differs from the parent variety chiefly in the higher color. Hitchings arose in the same way from Twenty Ounce, and is more highly colored than Collamer. Banks is another sport of a similar nature which arose from Gravenstein and differs from it primarily in color, being sometimes called the Red Gravenstein. Following this precedent, Red Duchess would be an appropriate name for the Bardwell sport.

While the origin of the new type herein described cannot be ascribed with certainty to a bud sport, on *a priori* grounds the evidence points that way. Since it has been equal to Duchess in productiveness and has shown the characteristic hardiness and vigor of this variety, it will be evident that there is a place for this Red Duchess where greater color is desired in an apple of this type.

Low Fecundity of Intellectual Negroes

Eugenics finds the same problem in the Negro race in America as in the white race, says Dean Kelly Miller of Howard University in the July issue of *The Scientific Monthly*. He finds that fifty-five members of the academic faculty at Howard have an average of 0.7 of a child each. While these families are not completed he is persuaded that the ultimate figure cannot be higher than two children per family—a number not sufficient to replace the parents. The families from which these fifty-five faculty members came average 6.5 children each. This low fecundity of intellectual Negroes is general, Dean Miller says. It is partly due to the long period of education which a Negro must have if he is to rise, partly to the high standard of living which he feels it necessary to maintain, and partly to the fact that some sensitive Negroes, feeling that their race is stigmatized as inferior, prefer not to have any children who must bear the burden of race prejudice.

A GOLDEN VARIETY OF RYE

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IN THE winter of 1914, while walking over a neglected field that had been sown with rye the previous year, I noticed many volunteer plants of this cereal, amongst them one with a distinct yellow foliage. I was curious to know if the plant was healthy or if the yellowness was due to some disease, so carefully lifted the plant and, after dividing it into three, had them planted on a small plat among some wheat experiments where they would be taken care of.

Owing to the fact that rye is almost entirely self-sterile it was necessary to grow a few normal plants by the side of this yellow one to insure the setting of some seed. With the idea of getting, by chance, one or two self-fertilized seeds, five ears were bagged in the usual way, but not a single seed was formed. The other ears, that were left to nature, set almost 100% of their flowers. This seed was harvested and sown the following year, 1915, on a plat 3 meters square, and as was expected practically all the resulting plants were normal green. One, however, was yellow like the mother plant, evidently self-fertilized. All the ears of this yellow plant were bagged and the result was the same as the first year, no seed being formed. The normal green plants gave a fair amount of seed which was sown the following season on a 10 by 10 meter plat. Again, as was expected, this seed produced green plants and yellow plants in the proportion of three of the former to one of the latter. All the yellow plants were dug out and planted on a small plat by themselves, and the green ones were destroyed before flowering time to prevent the pollen of green plants from fertilizing the flowers of the isolated yellow plants.

Unfortunately the locusts came while the plants were still young and tender, and destroyed the greater part of them, the result being that very little seed was obtained.

However, this amount of seed is quite enough to demonstrate that the yellowness of the plants is a true recessive character, and that when yellow plants are grown together a good distance from any green plants, and their seed harvested and sown, their progeny are all yellow, as is proved by our 1917 plat.

Now arises the question: How does the yellow plant lose its greenness? Is it due to susceptibility to some bacterial disease brought about by the dropping out of a factor the presence of which makes the plant ordinarily immune, or is it simply a case comparable with the "dilute" forms of hair color in animals, as, for example, the "blue" of the cat where the black pigment granules, scattered in the hairs, are so spaced out as to give the optical effect of "blueness." Here, the chlorophyll plastids are presumably so spaced out in the tissues of the plant that the optical effect is yellowness.

A microscopical examination has not been made to disprove the first theory, but, until the contrary is proved, it seems permissible to believe that it is a case of "dilution."

Apart from being of scientific interest this yellow race of rye may prove to be of practical value as a garden plant. Being quite hardy, its bright yellow color would give a striking effect in the flower garden during the winter months, and more especially in the early spring.

A PLANT WITH UNDERGROUND SPINES

PLANTS and animals both have developed spines as a means of protection against their enemies but it is rare indeed to find a plant with the spines below ground. The all too common sawbrier (*Smilax Bonanox L.*) of the southern states and northern Mexico is one of the few plants thus provided (Fig. 10). The stems above ground are spiny to keep off grazing animals but the underground starchy tubers are armored densely with spines apparently developed as a protection against peccaries—the wild pigs still found in the southwest. The sawbrier is undoubtedly spreading rapidly northward from Mexico and is now beyond the original range of the wild pigs but its armor comes into use against the ravages of the domesticated hog of the old world.

It is an interesting thing that the greenbriers of this region are very well fitted to survive against most of the adverse conditions imposed by civilization. They are all geologically newcomers in America and all actively spreading—some from the south and some from the east. *Smilax hispida* came in from the northwest ages ago and has now reached the Atlantic coast where it is found in association with *S. rotundifolia* whose relatives are all European. The invasion of the greenbriers will probably go on until they will all spread over the whole region.

The sawbrier (*Smilax Bonanox*) is better fitted to survive than any of its relatives who, while they have spines above ground, rarely have any below although they show enough traces of a spiny cover to suggest the way in which this interesting armor was evolved.

What Determines Longevity?

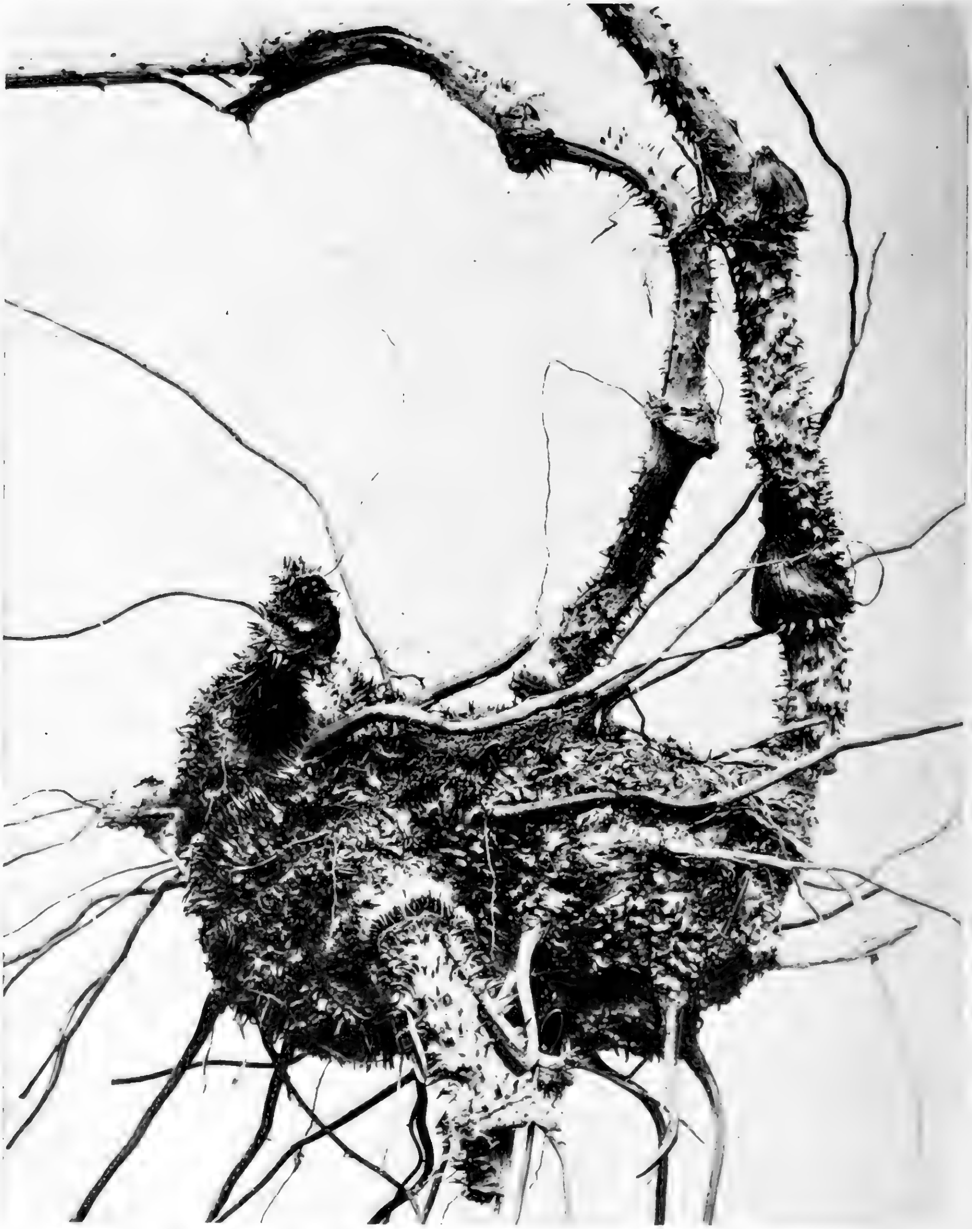
Under normal conditions, most complex animals have a characteristic and rather sharply defined duration of life. But one celled animals, which reproduce by fission, are apparently immortal unless life is stopped by what may be called an accident, for as the cell divides in half, neither part may be called the parent, and both halves will go on reproducing. And by taking cuttings from a plant, a part of the original may be kept living indefinitely by repeated cuttings, while the parent plant dies at the close of its usual duration of life. Thus it would appear that natural death is connected only with organisms which are composed of different organs which are inseparable.

Jacques Loeb and J. H. Northrop began experiments in 1908[1] in an attempt to find some of the causes which regulate the duration of life. Their work was carried on with the fruit-fly, Drosophila, which has a characteristic duration for both the larval and adult stages. It has already been definitely proved that the termination of the first stage of a metamorphosis is determined by the production in the body of certain chemical constituents not heretofore present.

It is known that various life processes have the same "temperature coefficient" as chemical reactions—every increase of 10° C. in the temperature doubles the speed of the process (or the reaction). This is, naturally, if such life-processes are themselves due to chemical reactions.

By breeding fruit flies at different temperatures, Loeb and Northrop seemed to find a similar temperature coefficient. Every increase of 10 degrees meant that the flies bred at that temperature reached the end of their lives just twice as rapidly as those bred in a temperature 10 degrees cooler. Hence, the authors think, it may be that longevity itself is determined by a chemical reaction—that normal death from old age is due to the production in the system of some poison which did not previously exist there.

[1] Loeb, Jacques, and J. H. Northrop. What Determines the Duration of Life in Metazoa? *Proc. Nat. Acad. Sci.*, iii, pp. 382–386. May, 1917.



UNDERGROUND SPINES FURNISHED DEFENSE AGAINST PECCARIES

The sawbrier (*Smilax Bonanox*) is one of the few plants which are furnished with underground spines. Its relatives all have spines above ground, but the sawbrier was forced to develop spines below ground as well in order to protect itself against the efforts of wild pigs to get at its starchy roots. Although the wild pigs are not now so numerous in many localities as to be a menace to the plant, the sawbrier still finds the spiny armor a valued protection against the domesticated hog. The above photograph is from a specimen collected in South Carolina by J. B. Norton, who is at present working on the relationship and past history of this group and the manner in which the different species reached America from the original home of the genus in northern India. (Fig. 10.)

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HORNED HORSES

VARIATION IN ARTICHOKES

REMARKABLE BUTTONBALLS

BULL TERRIER BREEDING

A HIT-OR-MISS UNIVERSE

WHEAT-RYE HYBRIDS

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